

Request for Proposal

Up gradation of Toll Collection and Management System (Volume I : Functional and Technical Requirements)

March, 2014

Issued by-

Noida Toll Bridge Company Limited

Noida

PROPRIETARY & CONFIDENTIAL

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Preface

This Request for Proposal (RFP) is being circulated by NTBCL. The purpose of this document is:

- To provide an introduction to NTBCL, its Toll Plaza, current operating environment and to list out the expectations from the proposed modernisation project as envisioned by the NTBCL
- To elicit proposals from competent and eligible Companies/Organizations/Consortia for undertaking this project

Through this RFP, NTBCL invites responses from Companies (Consortium of Companies) to propose a contractual arrangement for the provision, implementation and support for toll and traffic management hardware and software.

The RFP is documented over two volumes as follows:

Volume I: Functional and Technical Requirements

Volume II: Commercial Terms and Bid Documents

Responses should be organised in the format as detailed in the above documents to qualify for participation in the evaluation process. The last date for the receipt of proposals responding to the RFP is **April 4, 2014**.

This RFP is not an offer by NTBCL, but an invitation for response. No contractual obligation whatsoever shall arise from the RFP process unless and until a formal contract is signed and executed by duly authorised officers of NTBCL and the Company (Consortium of Companies).

1 Background and Scope of Work

1.1 The Company

The Noida Toll Bridge Company Ltd. (NTBCL) has been promoted by Infrastructure Leasing and Financial Services Ltd. (IL&FS) as a special purpose vehicle (SPV) to develop construct, operate and maintain the DND Flyway on a Build Own Operate Transfer (BOOT) basis. NTBCL is a public listed company, incorporated in Uttar Pradesh, India, in 1996 and operates only in India.

1.2 The DND Project

1.1.1. Location

The toll facility is located on the outskirts of Delhi, India, on the eastern end of the proposed Yamuna River bridge crossing. The facility consists of one mainline plaza and associated toll operation, ETC sales, toll administration and route maintenance buildings.

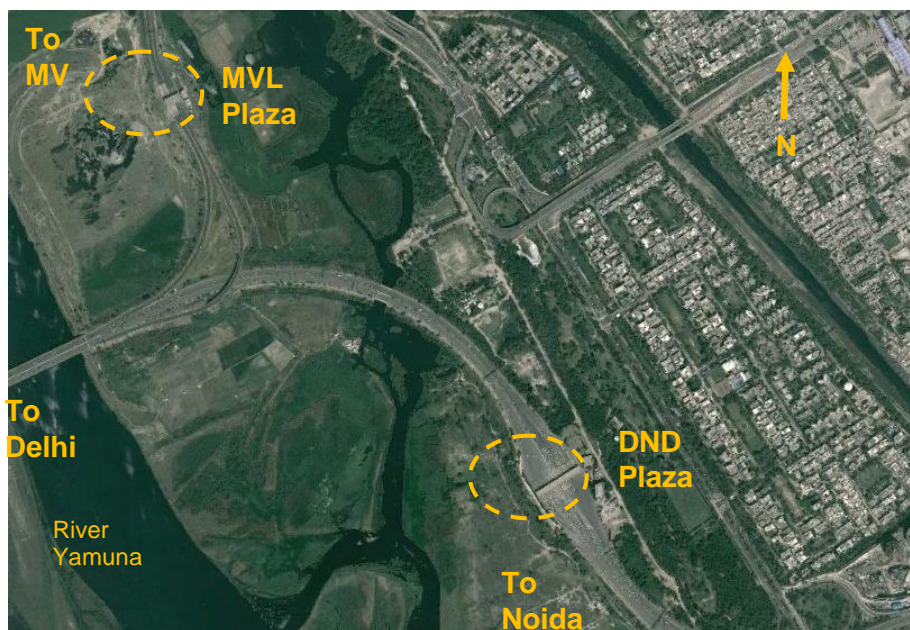


Figure 1.1: DND Location (* from Google Earth)

1.1.2. Project History

The DND flyway project was commissioned on February 7, 2001, almost 4 months ahead of schedule and broadly within the budget. The DND Flyway grew out of a need to bridge the growing population of Delhi with its neighbors' across the Yamuna. Today, 30% of Delhi's population lives in the Trans-Yamuna area and there was a need to build a major connecting facility between the area's growing on both sides of the Yamuna.

The project was supported by Indian and international engineers, contractors, operators and investors. The Flyway, an outcome of innovative technical and financial engineering, has been built with due care for environmental concerns. The Citizens Committee was formed to oversee the requisite environmental safeguards during construction - a feature pointed out by the World Bank as being the first of its kind in the world.

Later in January, 2008 Mayur Vihar Link (MVL) Toll Plaza with 11 lanes was commissioned. The Mayur Vihar Link Road was proposed to be developed by NTBCL to shorten the travel distance for people living in Mayur Vihar and others accessing areas in its vicinity. The MVL project of NTBCL covers the construction of a tolled link between the main carriageways of the DND Flyway and the VP Link road connecting NH-24 with MVL and Noida.

1.3 Toll Plazas

The Delhi Noida Direct (DND) Flyway was commissioned in February, 2001 with a 27 lane toll plaza (DND Toll Plaza) and later scaled up by adding four new lanes, thereby taking the total number of lanes at DND Toll Plaza to 31. In January, 2008 the Mayur Vihar Link (MVL Toll Plaza) with 11 lanes was commissioned.

At present, the Toll Plazas support the following types of lanes:

a) **Express lane for ‘non-stop’ Electronic Toll Collection (ETC)**

This lane has been named as the **Gold** lane by NTBCL to denote the premium service it offers to road users. Gold lane user vehicles possessing a valid On-board unit (OBU) are allowed to pay toll by driving ‘non-stop’ through the toll plaza.

Important features:

- I. Each OBU is linked to a pre-paid account maintained in the Toll System.
- II. Only Cars have been provided with the Gold lane facility
- III. Failure to possess a valid OBU results in the vehicle being barred entry into the Gold lane. Instead the vehicle is guided out smoothly (this process is called Ejection) to an adjacent lane for paying toll by other supported methods of payment. These methods typically include payment using a smart card (called as the Gold Card) issued to the ‘Gold’ user and linked to the OBU’s ETC account or by manual entry of ETC Account ID (E-Id) or by Cash.
- IV. Gold lanes are present only in the DND plaza

b) **‘Touch-n-Go’ lane dedicated for Electronic Toll collection (ETC) using Smart Cards**

This lane has been named as the **Silver** lane by NTBCL to denote the service it offers to the road users. Silver lane vehicles in the possession of a valid Smart Card are allowed to pay toll by touching their Smart Card to a reader located in the lane.

Important features:

- I. Each Smart Card is linked to a pre-paid account in the Toll System
- II. The Silver lane facility is offered to 4 Wheelers (Cars) as well as 2 Wheelers, but on separate lanes i.e there are separate Silver lanes for 2 Wheelers and 4 Wheelers.

In the case of detection of an invalid smart card a manual entry of the E-ID linked to the Smart Card is performed to complete the Transaction. In case this also fails or in the case the road user does not produce a Smart Card then the toll amount is collected from the user as cash. In the case of 2 wheelers the vehicle is escorted to a mixed lane for manual cash payment of toll. In the case of 4 Wheelers the lane system in the Silver lane is used to generate a toll transaction by cash collection.

c) **Mixed Lane**

The primary function of a Mixed lane is Toll collection by cash. These lanes also support Electronic Toll Collection via Smart Card readers for the benefit of Silver lane users who may prefer to use a Mixed lane due to reasons like lower queue lengths or the temporary closure of Silver lanes.

d) **Point of Sale (POS) lane**

The POS lane has been set up for the use of road users who have visited the main Point of Sale at the DND and MVL Plazas. These users are offered the facility of an exclusive lane (located behind the Toll Plaza building) to exit the toll plaza premises after visiting the POS. The POS lane is a Mixed lane supporting toll collection by cash and smart card.

e) **Test lane**

At this point of time the test lane is a physical lane without any tolling equipment. Its purpose is to perform toll collection system related tests and trials.

f) **Reversible lane**

This is a Mixed lane that can be operated, for toll collection, in either traffic direction.

Notes:

a) **ETC (Electronic Toll Collection)**

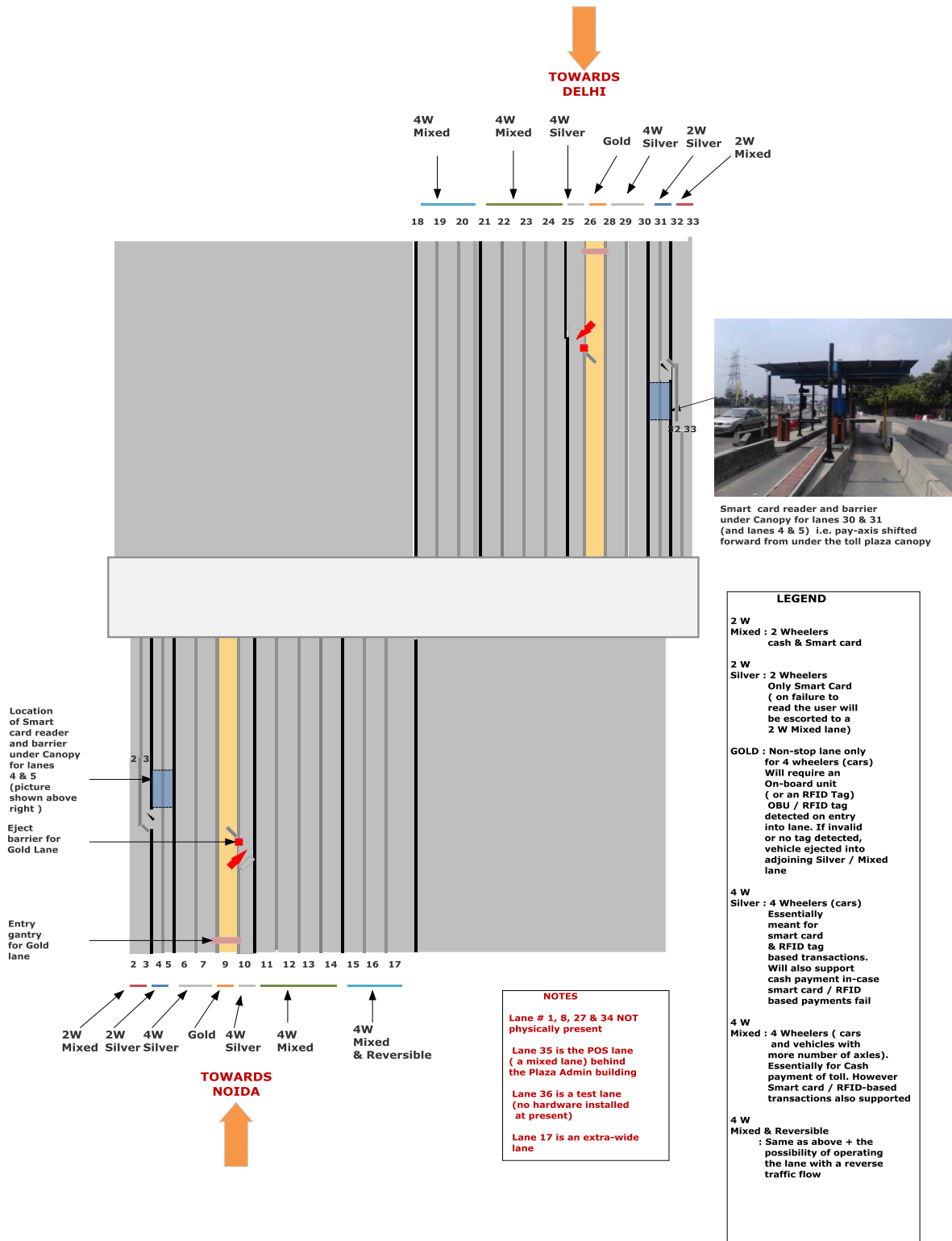
In the **context** of this project this term refers to an electronic form of toll collection and thus includes the methods of payment using smart cards as well the On-board units (OBUs).

b) 2 W stands for 2 wheelers

c) 4 W (denoting a 4 Wheeler), unless specifically qualified, stands for all mechanically powered vehicles that are not 2 wheelers.

d) A 2 wheeler entering a 2W Silver lane without a valid Smart Card is ejected to an adjacent Mixed lane by a manual process.

The lane layout at DND and MVL plazas are shown below in Figures 1.2 A & 1.2 B respectively and their features captured in Tables 1.1.A and 1.1.B respectively.

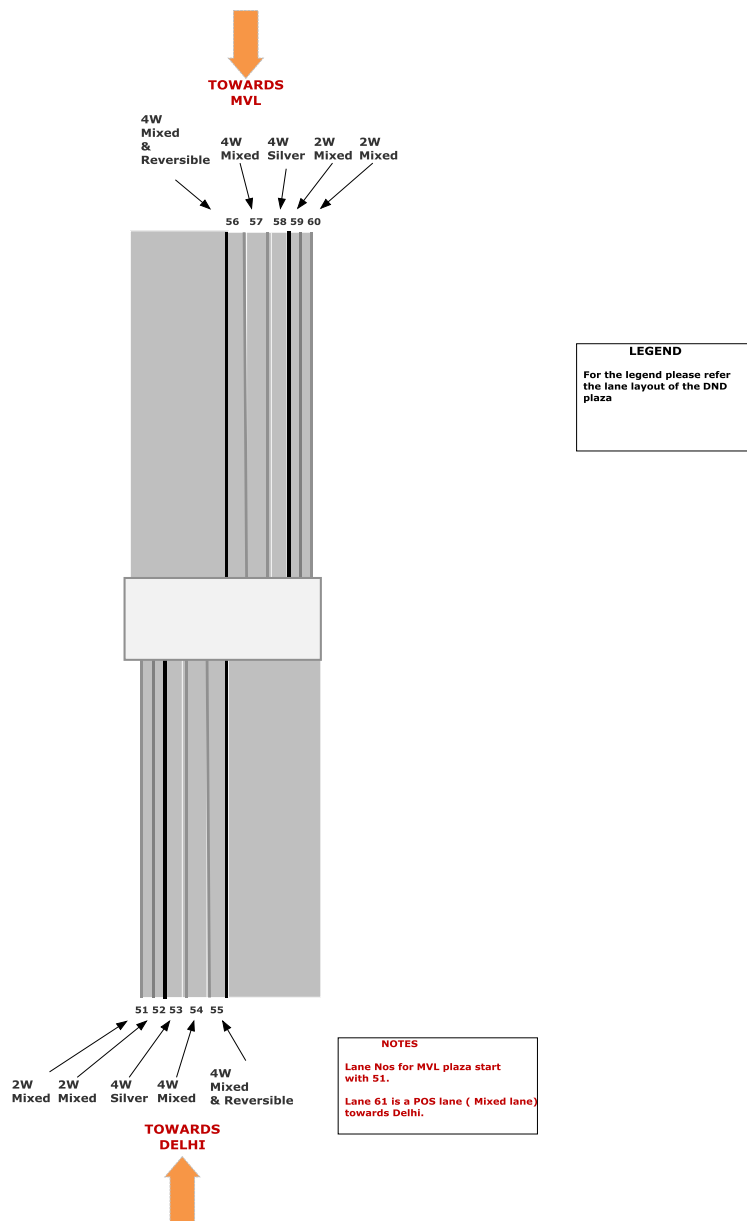


Note: This image can be zoomed for viewing the necessary details

Fig 1.2 A- DND Toll Plaza Lane layout – Present

DND : Mainline Plaza Configuration											
	Lane Type	Manual Cash Toll Collection	OBV Based Payment (ETC)	Smart card payment (ETC)	2W Lane	4W Lane	Gold Lane	Reversible Lane	POS	Ejection	Extra Wide
Lane 2N	2W Mixed	○●	○	○●	○●	○	○	○	○	○	○
Lane 3N	2W Mixed	○●	○	○●	○●	○	○	○	○	○	○
Lane 4N	2W Silver	○	○	○●	○●	○	○	○	○	○	○
Lane 5N	2W Silver	○	○	○●	○●	○	○	○	○	○	○
Lane 6N	4W Silver	○	○	○●	○	○●	○	○	○	○	○
Lane 7N	4W Silver	○	○	○●	○	○●	○	○	○	○	○
Lane 9N	4W Gold	○	○●	○	○	○●	○●	○	○	○●	○
Lane 10N	4W Silver	○●	○	○●	○	○●	○	○	○	○	○
Lane 11N	4W Mixed	○●	○	○●	○	○●	○	○	○	○	○
Lane 12N	4W Mixed	○●	○	○●	○	○●	○	○	○	○	○
Lane 13N	4W Mixed	○●	○	○●	○	○●	○	○	○	○	○
Lane 14N	4W Mixed	○●	○	○●	○	○●	○	○	○	○	○
Lane 15N/D	4W Mixed	○●	○	○●	○	○●	○	○●	○	○	○
Lane 16N/D	4W Mixed	○●	○	○●	○	○●	○	○●	○	○	○
Lane 17N/D	4W Mixed	○●	○	○●	○	○●	○	○●	○	○	○●
Lane 18D	4W Mixed	○●	○	○●	○	○●	○	○	○	○	○
Lane 19D	4W Mixed	○●	○	○●	○	○●	○	○	○	○	○
Lane 20D	4W Mixed	○●	○	○●	○	○●	○	○	○	○	○
Lane 21D	4W Mixed	○●	○	○●	○	○●	○	○	○	○	○
Lane 22D	4W Mixed	○●	○	○●	○	○●	○	○	○	○	○
Lane 23D	4W Mixed	○●	○	○●	○	○●	○	○	○	○	○
Lane 24D	4W Mixed	○●	○	○●	○	○●	○	○	○	○	○
Lane 25D	4W Mixed	○●	○	○●	○	○●	○	○	○	○	○
Lane 26D	4W Gold	○	○●	○	○	○●	○●	○	○	○●	○
Lane 28D	4W Silver	○	○	○●	○	○●	○	○	○	○	○
Lane 29D	4W Silver	○	○	○●	○	○●	○	○	○	○	○
Lane 30D	2W Silver	○	○	○●	○●	○	○	○	○	○	○
Lane 31D	2W Silver	○	○	○●	○●	○	○	○	○	○	○
Lane 32D	2W Mixed	○●	○	○●	○●	○	○	○	○	○	○
Lane 33D	2W Mixed	○●	○	○●	○●	○	○	○	○	○	○
Lane 35N	Mixed	○●	○	○●	○●	○●	○	○	○●	○	○

Table 1.1.A – DND Plaza Toll lanes – List of features (present)



Note: This image can be zoomed for viewing the necessary details

Fig 1.2 B- MVL Toll Plaza Lane layout - Present

DND : Mayur Vihar Link Plaza configuration											
	Lane Type	Manual Cash Toll Collection	OBU Payment (ETC)	Smart card payment (ETC)	2W Lane	4W Lane	Express Lane	Reversible Lane	POS	Ejection	Extra Wide
Lane 51D	2W Mixed	○●	○	○●	○●	○	○	○	○	○	○
Lane 52D	2W Mixed	○●	○	○●	○●	○	○	○	○	○	○
Lane 53D	4W Silver	○	○	○●	○	○●	○	○	○	○	○
Lane 54D	4W Mixed	○●	○	○●	○	○●	○	○	○	○	○
Lane 55D	4W Mixed	○●	○	○●	○	○●	○	○●	○	○	○
Lane 56M	4W Mixed	○●	○	○●	○	○●	○	○●	○	○	○
Lane 57M	4W Mixed	○●	○	○●	○	○●	○	○	○	○	○
Lane 58M	4W Silver	○	○	○●	○	○●	○	○	○	○	○
Lane 59M	2W Mixed	○●	○	○●	○●	○	○	○	○	○	○
Lane 60M	2W Mixed	○●	○	○●	○●	○	○	○	○	○	○
Lane 61M	Mixed	○●	○	○●	○●	○●	○	○	○●	○	○

Table: 1.1.B – MVL Plaza Toll Lanes – List of features (present)

DND Flyway, the direct connection between Delhi and Noida was opened to traffic in February 2001. The traffic on this facility (DND and MVL) has steadily increased and has now exceeded 130,000 vehicles on a daily basis. The details of traffic are as follows:

S No	Plaza Location	Average Traffic Per Day	Average Peak Hour Traffic Per Day
1.1	DND Toll Plaza	1,10,000	12,000
1.2	MVL Toll Plaza	25,000	3,000
	Total	1,35,000	15,000

Table: 2 – Traffic Figures for DND and MVL Plazas

1.4 Toll Operations and Maintenance

On June 22, 2007 ITNL Toll Management Services Limited (ITMSL) was incorporated as a joint venture company with IL&FS Transportation Networks Limited, who have significant experience in operations and maintenance of toll road projects.

ITMSL was set up to carry out O&M services for Noida Toll Bridge and other similar ventures on a pan- India basis. The O&M services of the bridge have been taken over by ITMSL since August 1, 2007.

1.5 Need for upgrading the Toll System

The traffic forecast for the DND Flyway and the Mayur Vihar Link (MVL) Road has been reviewed in light of the substantial population growth in the region. The traffic is expected to grow significantly. The upgraded toll management system should have the capability to handle 2,50,000 daily vehicle trips. It is expected that in the financial year ending 2021, there will be 200,504 daily vehicle trips on DND Flyway.

NTBCL through this RFP is identifying suitable vendors with relevant expertise for design, supply, installation & commissioning of toll collection and management system. NTBCL strives to set up a leading-edge toll collection and management system that will:

- Use State-of-the-Art technology including an open and scalable architecture
- Provide a highly available and highly resilient performance &
- Prove Cost-effective and energy-efficient

1.6 Scope of the Work for the up gradation project

1. Design, Engineering and Supply of the proposed upgrade toll collection and management system as per the specifications provided in this RFP. Further:
 - a) The proposed system shall also have the capability to support the use of the On-board Units (OBUs) belonging to the continuing premium Gold lane service that supports non-stop ETC. Presently there are more than 10000 premium Gold lane customers of DND with OBUs. While DND may choose to phase out these OBUs at a later date and replace them with RFID tags, it is important that they be fully supported until such an initiative is effectively carried out.
 - b) The proposed system shall also have the capability to support the use of Contactless Smart Cards belonging to the current Silver

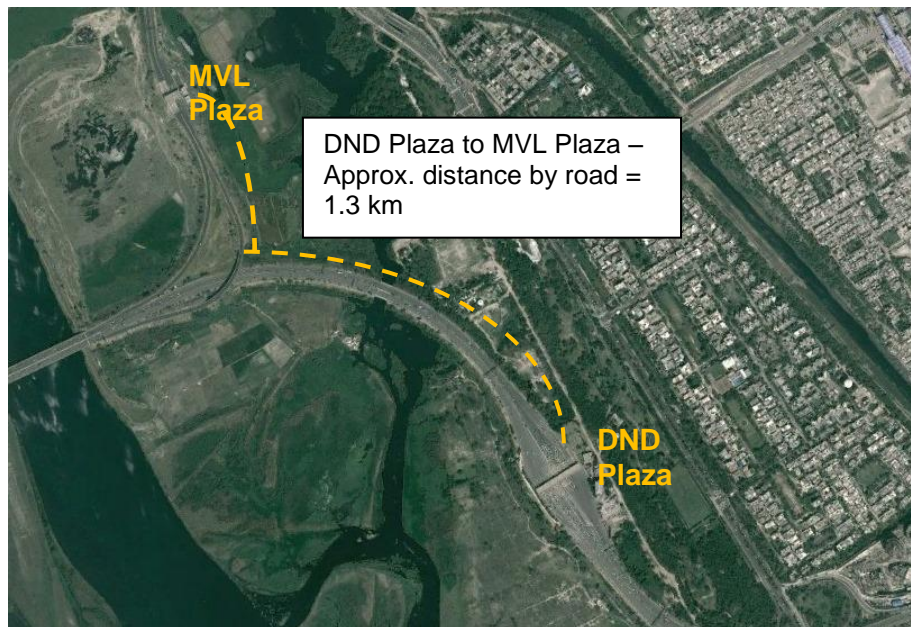
lane service. Presently, there are more than 100,000 Silver lane customers.

- c) The present toll system includes several equipment assets (e.g. UPS units, Printers, Network Switches....) that may effectively be re-used in the proposed system. NTBCL wishes that such assets shall be effectively re-used to the maximum extent possible with the successful bidder taking full responsibility for their performance during the system installation, commissioning, defects liability period, warranty period and the maintenance period under the Annual Maintenance Contract.
2. Implementing a smooth process of progressive de-installation of the existing Toll collection and management system from the lanes and other areas like the admin building, POS etc followed by simultaneous, progressive installation and commissioning of the proposed Toll collection and management system. A broad approach for the same has been provided in this RFP.
3. On-Site Warranty Support for the entire system (including the sub-system that interfaces with the OBUs) for a period of 2 years after the defects liability period (which is a period of 3 months after system commissioning) followed by an on-site maintenance support for the entire system (including the sub-system that interfaces with the OBUs) for a further period of 3 years in the form of an Annual Maintenance Contract

2 EXISTING TOLL FACILITIES

2.1 General

The information in this chapter is provided for the information of the bidders. All measurements (e.g. lane widths) are approximate and should be used for estimate purposes only. Bidders need to further revalidate the same based on physical inspection and measurement if required. Figure 2.1 indicates the general arrangement of the toll plaza and plaza building.



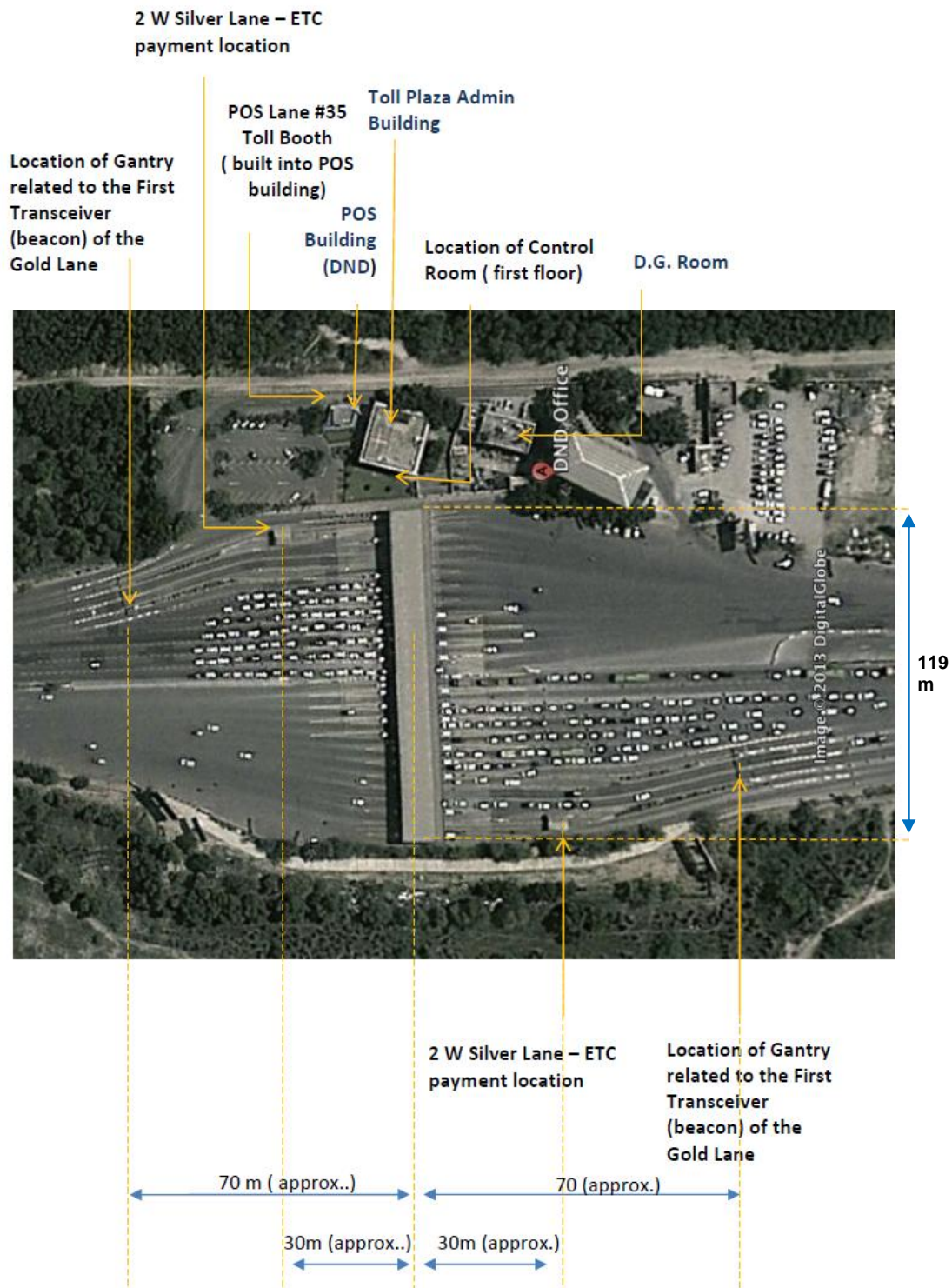




Fig 2.1: DND and MVL Toll Plaza layouts

Canopy details DND and MVL (approximate Dimensions)

S No	Plaza	Length (Mts)	Width (Mts)	Height (Mts)
1.	DND	119	15	5.5
2.	MVL	38	16.5	6

Toll Booth Dimensions:

Single Booth: 1.9 m (L) x 1 m (B) x 2.5 m (H)

Double Booth: 3.9 m (L) x 1 m (H) x 2.5 m (H)
(for reversible lanes)

The length (L) dimension denotes the dimension parallel to the road / lane.

2.2 TOLL OPERATION RELATED FACILITIES

2.2.1 Toll Lanes

The toll infrastructure consists of 31 existing lanes at the DND Plaza and 11 existing lanes at the MVL plaza. The lanes are categorized as follows:

DND

S.No	PLAZA	Lane Type	Direction	No of lanes
1	DND	2 W Mixed	Towards Noida	2
2	DND	2 W Silver	Towards Noida	2
3	DND	4 W Silver	Towards Noida	2
4	DND	4 W Gold	Towards Noida	1
5	DND	4 W Silver	Towards Noida	1
6	DND	4 W Mixed	Towards Noida	4
7	DND	4 W Mixed & Reversible	Towards Noida (Default direction is towards Noida)	3
8	DND	4 W Mixed	Towards Delhi	7
9	DND	4 W Silver	Towards Delhi	1
10	DND	4 W Gold	Towards Delhi	1
11	DND	4 W Silver	Towards Delhi	2
12	DND	2 W Silver	Towards Delhi	2
13	DND	2 W Mixed	Towards Delhi	2
14	DND	2 W / 4 W Mixed	Towards Noida (POS Lane) – Supports all classes	1
			TOTAL	31

Table 2.1 – DND : No of lanes and their types

MVLR

S.No	PLAZA	Lane Type	Direction	No of lanes
1	MVL	2 W Mixed	Towards Delhi	2
2	MVL	4 W Silver	Towards Delhi	1
3	MVL	4 W Mixed	Towards Delhi	1
4	MVL	4 W Mixed & Reversible	Towards Delhi (Default Direction is towards Delhi)	1
5	MVL	4 W Mixed & Reversible	Towards MVL (Default Direction is towards MVL)	1
6	MVL	4 W Mixed	Towards MVL	1
7	MVL	4 W Silver	Towards MVL	1
8	MVL	2 W Mixed	Towards MVL	2
9	MVL	2 W / 4 W Mixed	Towards Delhi (POS Lane) (Supports all classes)	1
			TOTAL	11

Table 2.2- MVL: No of lanes and their types

Future Expansion

We are planning to construct 4 additional lanes on DND and 4 additional lanes on MVL. The 4 additional lanes at the DND plaza and the MVL plaza will be constructed at the opposite end of the Toll Plaza canopy that is away from the Toll Plaza Admin building. Thus the proposed toll collection and management system shall have a minimum 25 % additional capacity.

2.2.2 Lane related dimensions - DND & MVL

The toll lane widths are measured between kerb / New Jersey barriers at finished road levels at the edges of the toll islands:

- ✓ The width of the toll islands is 1.8 meters measured from the outer edges of the island
- ✓ Lane width: Normal 4 W lane = 3.2 m, Extra wide 4 W lane = 5.5 m, 2 W lane = 1 m.

- ✓ The length of the toll island is 21.5 meters measured from the bull nose front to the rear edge of the toll island. Toll islands applicable to reversible lanes are approximately 24 meters long
- ✓ The absolute minimum vertical canopy clearance standard is 5.5m. (The desirable clearance of 5.75m)

2.2.3 Service Tunnel

A service tunnel is provided underneath the toll islands and connected to the plaza building. The internal dimension of the tunnel is approximately 2m x 2m. The tunnel is located immediately beneath the concrete pavement.

The service tunnel accommodates all necessary electric and electronic cabling services to the tollbooths and all equipment.

2.2.4 Plaza Building

The plaza building accommodates the following facilities requiring interface with the toll collection system:

- ✓ Toll control room
- ✓ Computer room
- ✓ Cash-up room
- ✓ Cashier's cubicle

Sr. NO	Workstation	DND	MVL
1	Cash up	1	1
2	POS	4	
3	Cashier	1	1
3	IC	3	2
4	Admin	Included in above	Included in above

Table 2.3. Workstations

2.2.5 Network Infrastructure

The existing Toll system employs a set of Network switches (TCP/IP) to ensure connectivity between its various elements like TLC, AVC, servers and the various workstations

2.2.6 Power Supply and Distribution

The existing Toll System, each Toll Plaza, is primarily provided electrical power from the state utility grid supported by a Diesel Generator back-up. The measures taken to ensure that the Toll system is provided un-disrupted quality power are the following:

- a) Wide variations in the voltages of the incoming power are eliminated by the use of a Servo Voltage Stabiliser.
- b) Further in order to ensure a high level of system availability in the face of a failure in the power supply system itself, an optimally structured set of Uninterrupted Power Supplies (UPS) are employed as follows:
 - I. Each TLC is provided power from an individual UPS unit
 - II. Each AVC is provided power from an individual UPS Unit
 - III. The Server system is provided power from a hot-standby UPS system.
 - IV. The Workstations (including the LSDU) and the rest of the Toll system (distributed across the Toll Plaza) are provided UPS supported power supply.

3 Operational Requirements

3.1 Introduction

3.1.1. Traffic Growth

As explained in an earlier section, the traffic forecast for the DND Flyway and the proposed Mayur Vihar Link Road has been reviewed in light of the substantial population growth in the region. The traffic is expected to grow significantly. The upgraded toll collection and management system shall have the capability to handle 2,50,000 daily vehicle trips. It is expected that in the financial year ending 2021, there will be 200,504 daily average vehicle trips on DND Flyway.

3.1.2. Growth of Electronic Toll Collection

With continuing increase of traffic at the plazas, a major concern with regard to the user experience is the increasing waiting time, especially during peak hours.. Waiting times can be substantially controlled by increasing the proportion of ETC transactions. Therefore DND is further stepping up its initiatives to aggressively grow the ETC component in its program.

3.1.3. Toll system upgrade

Therefore what DND requires is a leading-edge toll collection and management system that will:

- Use State-of-the-Art technology including an open and scalable architecture.
- Provide a highly available and highly resilient performance &
- Prove cost-effective and energy-efficient to perform in an environment of vigorous growth especially in ETC.

3.1.4. Main functions

The proposed Toll collection and Management System shall perform the following two main functions:

- a) Collect Toll from users for the use of the **DND Flyway** or the **Mayur Vihar Link Road (MVLR)**.
- b) Collect the **Municipal Corporation of Delhi (MCD) entry tax** for commercial vehicles entering into Delhi.

The MCD entry tax collection will be performed on those Mixed and Silver toll lanes of the DND Plaza that are directed towards Delhi including all reversible lanes.

3.1.5. System Organization

Keeping in mind the rigorous growth planned for the ETC component of the Toll Collection and Management System the proposed upgrade system shall be organized in two interacting parts with each performing the following functions:

Part A shall be the Primary **Toll Collection and Management System (TMS)** performing the main roles of:

- Transaction generation at the lanes for both Cash and ETC including the AVC and other related functions described in this RFP.
- Transaction processing of Cash Transactions including violation audit (incident management)
- Transaction processing of ETC transactions limited to violation audit.
- Lane re-charges of ETC User accounts
- Cash-up & Cash Management
- Toll tariff management
- Report Generation
- ETC Client
 - Holding the current user account whitelists (including individual current account balances) , blacklists for quick reference by the lane software in all lanes to check on-line the validity of an ETC Account
 - Holding the non-settled ETC transactions for transfer to the ETC back office system

- Transfer of the above transactions to the ETC Back end system (Part B) or any other ETC back end system (e.g. the CCH belonging to the Nation-wide ETC program)
- Receiving current whitelists (including individual current account balances), blacklists of ETC User accounts from the ETC back office system (Part B) or any other ETC back office system (e.g. the CCH belonging to the Nation-wide ETC program) and suitably updating the respective lists being held.
- Other functions described in the RFP like the Lane status Display Unit, not specifically listed under Part B below

Part B shall be the **ETC backend system (ETC Backend)** performing the main roles of

- ETC host holding all ETC User accounts including the balances
- Transaction settlement of ETC transactions received from the ETC client of Part A
- Point of Sale system including those features related to POS terminals
- Road-User web portal for on-line recharge and generating usage reports
- Stock Management of Smart cards, RFID tags and OBUs
- Generation of whitelists (including individual current account balances), blacklists and sending them to the TMS via the ETC client
- Sending SMS / E-mail messages to ETC Users e.g. ETC Transaction, Low balance threshold reached and Receipt of Payment.

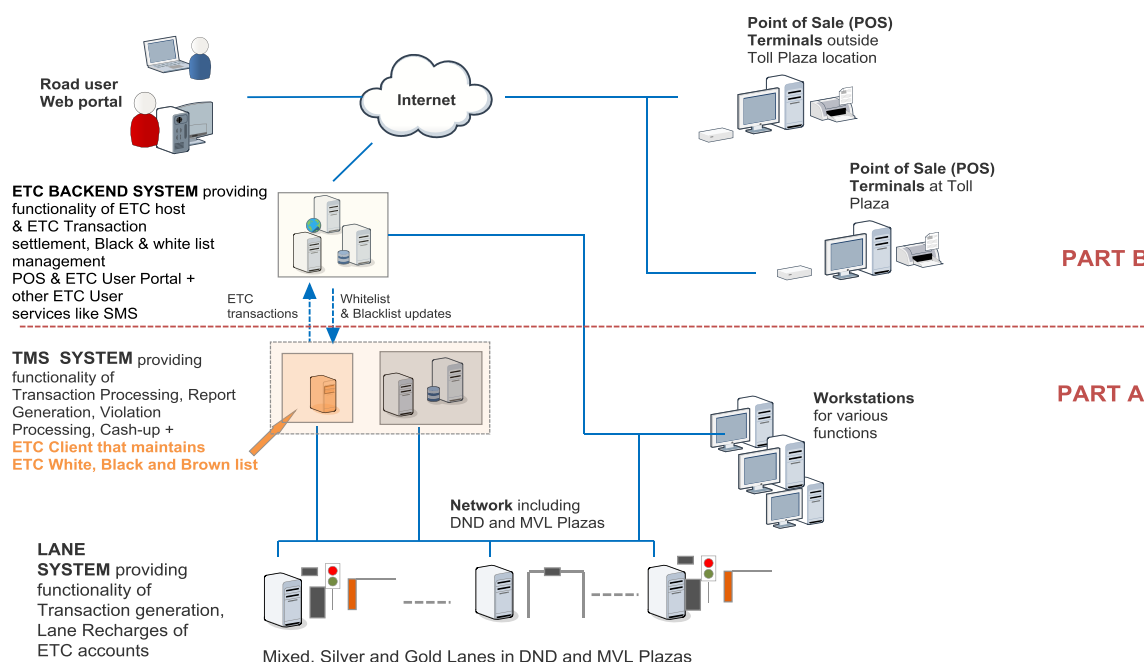


Fig 3.1. System Organization

3.2 Functional Requirements

3.2.1 Vehicle Classes

This section describes the Vehicle classes for Toll and MCD entry tax collection.

3.2.1.1 Vehicle Classes for Toll Collection

- a) The toll equipment shall be capable of automatic classification (requiring no human assistance or intervention) of various vehicle types into six classes.
 - A “motor vehicle” is defined as an entity comprising of one mechanically powered unit with or without trailer(s) physically joined by means of tow bars, tow ropes or mechanical articulation, and includes:
 - i) a motor cycle;
 - ii) a motor tricycle (three-wheeler);
 - iii) a motor car; and
 - iv) a vehicle that has pedals and a mechanically powered unit as an integral part thereof or attached thereto and which is

designed or adapted to be propelled by means of the pedals or the mechanically powered unit or both.

The **classification system** that shall be followed for **Toll Collection** is given in Table 3.1. below:

S.No	Vehicle Class	Description	Indicative Parameters
1	I	Two Wheeler	-
2	II	Car/Van/Jeep/Tractor (without trailer(s) / Three-Wheeler	Height < 1.97 m
3	III	LCV / Mini Bus	<u>Height above first axle</u> 1.97 m < Height < 2.4 m, <u>Axles</u> No of Axles = 2
4	IV	Truck / Bus	<u>Height above first axle</u> 2.4 m < Height <u>Axles</u> No of Axles = 2
5	V	Multi-Axle Vehicle (MAV) Type 1	<u>Height above first axle</u> 2.4 m < Height <u>Axles</u> No of Axles = 3
6	VI	Multi-Axle Vehicle (Type 2) Type 2	<u>Height above first axle</u> 2.4 m < Height <u>Axles</u> No of Axles > 3

Note: The parameters shown in the above table for the various classes are indicative only, The AVC offered by the bidder shall be effective enough to classify with the required accuracy in case of minor variations in the above parameters.

Table 3.1 (a) : Vehicle Classes for Toll Collection

Notes to Table 3.1 (a):

- a) All applicable / available AVC parameters shall be configurable by the Concessionaire (NTBCL). The Concessionaire shall be able to add, deactivate any of the current class of vehicle and modify any classification parameter value.
- b) At this point of time MAV classes are only 2 in number i.e. 3 axles and > 3 axles. However the AVC system shall be designed in such a manner that, in future, it shall be possible to define and collect toll based on vehicle classes based on the number of axles (i.e. 4, 5,6,7 etc shall each correspond to a single MAV Class). For the present, however, whenever Class VI key is used, the system shall accept the MOP key input only after taking the number of axles input from the Toll Collector and confirmed by ENTER key.
- c) In the above table a parameter specification stating that 2.4 m < Height means that the Height must be greater than 2.4 m.
- d) Vehicles like Earth Moving Vehicles and Heavy Construction Machinery shall also be classified based on the scheme provide in Table 3.1(a)

3.2.1.2 Vehicle Classes for MCD Entry Tax collection

S.No	Vehicle Class	Description
1	I	Car/ Van / Jeep / Tractor / Three Wheeler / LCV / Mini-Bus
2	II	Bus / Heavy Construction Machinery
3	III	Truck (6 Wheel)
4	IV	Multi-Axle Vehicle (MAV -10 Wheel) Type 1

5	V	Multi-Axle Vehicle (MAV-14 Wheel) Type 2
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Table 3.1 (b) : Vehicle Classes for MCD Entry Tax collection**Notes to Table 3.1(b):**

1. The classification for MCD Entry tax for trucks is based on the number of Wheels e.g. a 2 axle truck with double wheels in the rear axle has 6 wheels in all.
2. Further a vehicle due for collection of MCD tax shall be automatically detected by the lane system based on the yellow background of the number plate.

3.2.2 Methods of Payment for Toll Collection

The system shall be capable of accepting, validating and recording toll transactions under any one of the following methods of payment (MOP):

1. Pre-paid Electronic Toll Collection (ETC)
 - a. Pre-paid Smart card
 - i. Smart card with Individual account
 - ii. Fleet card (Several Smart cards attached to a single account referred to as the Corporate Account)
 - b. Pre -paid RFID tag
 - i. RFID tag with Single account
 - ii. Fleet tag (Several RFID tags attached to a single account referred to as the Corporate Account)
 - c. Pre-paid On-Board Unit (OBU)
2. Cash
 - a. Single Journey
 - b. Return Journey
3. Bank-issued Credit Cards
4. Exempt passage
5. Violations

Notes:

1. Although the Exempt Passage and Violations are strictly not methods of payment of toll (as they do not involve actual payment) they are included here as ways one can pass through a toll lane with zero payment of toll.
2. As there are around 100,000 Contactless Smart Cards issued to existing Silver Lane users it is important that they continue to be supported in the upgrade system. These cards are the Mifare Type A, 1 KB operating at 13.56 Mhz.

3. As there are over 10,000 existing premium users using the Gold Lane facility with the OBU it is important that this method of payment shall continue to be supported in the proposed toll collection and management system. Thus the ETC payment in the Gold lane of the proposed system shall support both the RFID as well as the present OBU technology. In the lanes, the OBUs are read by a Control Unit via a Transceiver (also called a 'Beacon') working in the Infrared (IR) band while at the POS they are programmed using a Programming unit connected to a POS workstation. The Control Unit itself interfaces with the Toll Lane Controller of the Gold Lane. For the purpose of integrating the present OBU Technology with the TLC of the proposed system, NTBCL will arrange to obtain and provide the successful bidder, the interface details from the vendor of the present OBU technology.

NTBCL may phase-out the OBU system at a future date and migrate all OBU users to the proposed Gold Lane RFID system.

4. The system shall also support payment of toll using Credit Card. For this purpose each lane shall have a PCI Data Standards compliant credit card terminal interfaced to the TLC (in hardware and software). More details are provided in section 4.15.

3.2.2.1 Prepaid Electronic Toll collection (ETC)

1. Electronic toll collection (ETC) shall require a user to purchase, pay a deposit for, or receive free issue of an electronic identifier unique to that User and linked to an electronic account (user account) maintained on the ETC Backend System).

The user's electronic identifier shall be carried in the following media:

- a) Contactless Smart Cards
- b) RFID-based tags that are affixed on the windshield of the vehicle.
- c) OBUs

a) ETC payment with the Contactless Smart Card

By using the contactless smart card the user can pass through the toll lane by 'touching' the smart card to the smart card reader installed at the lane. The electronic identifier in the smart card shall be read by the system during this process, checked for validity and an ETC transaction for the toll fee amount generated for the passage. The vehicle shall then be automatically guided out of the toll lane. The transaction shall be processed later and the related user account in the ETC Backend system appropriately debited by the toll fee amount.

b) ETC payment with the RFID tag

With a vehicle having an appropriately affixed RFID tag, the tag's contents including the unique vehicle identifier shall be read by lane-specific transceiver(s) attached to the system, checked for validity and an ETC transaction for the toll fee amount generated for the passage. The vehicle shall then be automatically guided out of the toll lane. The transaction shall be processed later and the related user account in the ETC Backend system appropriately debited by the toll fee amount.

c) ETC Payment with the OBU

With a vehicle having an appropriately affixed OBU, the OBU's contents including the unique vehicle identifier shall be read by lane-specific transceiver(s) attached to the system, checked for validity and an ETC transaction for the toll fee amount generated for the passage. The vehicle shall then be automatically guided out of the toll lane. The transaction shall be processed later and the related user account in the ETC backend system appropriately debited by the toll fee amount.

2. ETC identifiers (i.e. media like Smart Cards, RFID-tags) shall be appropriate for closed (cars, trucks etc.) and open (two-wheelers) vehicles under all weather conditions.
3. A User utilising ETC passage will be required to deposit funds into the ETC account depending on the User's expected use of the toll facilities. The value of each trip will be deducted from the balance
4. The User utilising ETC passage shall be notified, via the User Fare Display (UFD), the applicable toll amount and the remaining balance in the user account.. . Passage shall not be granted when the account is blacklisted.
5. A user misusing ETC by using it for a higher class (or lower) vehicle not originally expected to be used (e.g. a Class III vehicle using a ETC media issued to a Class II vehicle) shall be charged an additional penalty for such wrong usage.
6. The ETC backend system shall have the facility to invalidate ETC identifiers that have been lost, stolen or withdrawn from circulation or which need to be removed for any reasons.
7. The User will have to replenish or top-up the ETC account balance by depositing adequate funds into the user account. This can be performed in the following ways:
 - a) The User can top up the user account using cash or credit / debit card at the point of sale (POS) facility located in the DND toll plaza or any other notified location .
 - b) The User can utilise an on-line web-based payment mechanism. The web interface needs to be a secured system duly integrated with payment gateways. Arrangement of a suitable payment gateway shall be in the bidder's scope.

- c) The user can also pay by cheque / DD at the POS or the designated Toll lane(s).
8. The users should have access to a customer web-portal that will provide reports on usage and account balance against their ETC accounts. This portal shall also enable the on-line payment (described in point b) above) to top-up the ETC account. All payments for top-ups/new issues shall be activated on the lanes within a short span of time (less than 5 minutes) after the transaction is completed
9. Pre-paid ETC using a Corporate account differs from a single account in that several individual ETC media (Smart cards, RFID tags, OBU's) can be linked to a common account that will be maintained by the Customer.
10. Anti-pass back: This feature shall be applicable for ETC users. In a defined time period the account shall be debited only once in a lane. The timer shall be configurable by NTBCL authorised staff.

3.2.3 Tariffs

- a) There will be tariffs associated to each class of vehicle. The equipment shall have the facility to grant various predefined levels of concession or discount within each MOP up to 100% discounted payment for any class of vehicle. The system shall allow for up to thirty levels of concession or discount. The discount granted within each level will be different for all the methods of payment.
- b) The system shall allow for the instantaneous implementation of tariff changes at designated times in batch mode. The system shall also allow for a weekly tariff profile within which at least five (5) time dependant tariff changes can be programmed for each day of the week for each class of vehicle. Before a tariff change is implemented, the system must notify the toll collector that the tariff change will take effect from the following transaction, and allow the toll collector to finish the current transaction.

- c) The system shall then automatically logout the toll collector, implement the new tariff, and prompt the toll collector to login again. It shall then inform the toll collector that a new tariff table has been applied.

3.3 Tariff Table

The tariff table shall be structured in two parts:

- a) The first part of the fare table comprises of the nominal fare that is expected to be paid by each user depending on the class of his / her vehicle. This shall be a class wise fare table where the Operator is able to feed the amount to be paid against each class. There shall be an additional column to apply tax (class wise with the option of defining the tax as a fixed sum / percentage of the toll fare – configurable). The third column shall contain the total tariff rounded off-calculated (to the nearest rupee / five rupees – configurable). There shall be a fourth rounded off-actual column, which shall by default carry the same value as the third column. However, it shall be possible for the Concessionaire to feed actual amount, in case it is different from the calculated amount as per the Fee Notification.
- b) The second part of the fare table contains all the privilege tariff information. This shall have multiple tables, each corresponding to a different type of fee structure / privilege / scheme. Each contract type added by the Concessionaire to the ETC module shall automatically update a separate table in this special tariff table section.

3.4 Tariff Table Structure

The tariff table has the following hierarchical structure:

A. Operator

This level defines a tariff table for each toll plaza operator, in case of interoperability of a payment method.

A.1. Privilege level

The concessionaire can create and assign privilege to customers (Users) who have an account in the system and charge different tariffs for each privilege.

A.1.1. Plaza

Tariffs are defined for each plaza of the concessionaire

A.1.1.1. Sub Plaza

Each plaza can have sub plazas that operate under a main plaza, having different tariffs

A.1.1.1.1. Method of Payment

Tariffs can be defined for each method of payment and / or Scheme

A.1.1.1.1.1. Day of the week

Tariffs can be defined for each day of the week

A.1.1.1.1.1.1. Time of day

Tariffs can be defined for time periods within a weekday

A.1.1.1.1.1.1.1. Class of vehicle

Tariffs are defined for each vehicle class. A.1.1.1.1.1.1.1.1. Tariff

Tariff amount

Two privileges shall be reserved for the system, one for the nominal tariff and the other for full exemption.

3.5 Tariff Change Management

Tariff tables are defined according to the structure shown in the previous sub-clause and each table has associated to it, a date and time to become effective in the system. The system will keep an audit trail of tariff table definition and changes. All old tariff tables shall be maintained as a different version in the system with date of activation, created by, date of expiry (same as date of activation of the new version) and shall be stored in the TMS for future audits.

It shall be possible to schedule tariff revisions by setting date and time. Any modification in a single table shall be considered a new version, and for all

those tables where there is no modification, the previous version's tariff shall be carried over. Tariffs shall be defined at TMS level and down-loaded to the TLC. The TLC shall keep the current table and the scheduled tables.

Tariff tables shall be implemented in the TLC as described below:

- The TLC automatically initiates a tariff table change procedure when the current date and time matches the corresponding date and time of a scheduled table.
- The TLC initiates a tariff change procedure when there is a change in the tariff amount due to a change in the day of the week or if there is a different tariff for the period of time starting at the current time.
- Whenever there is a change in the tariff, the toll collector is requested to acknowledge the change. The toll collector will not be able to proceed with the transaction unless he acknowledges the tariff change.

Owing to the criticality of the above table, the following security measures shall be employed:

- Whenever, a tariff table modification is initiated by the Operations Manager he shall be allowed to save this as a temporary version for further validation from the General Manager. Only, when the General Manager corrects and / or validates the version, the new version shall be transmitted to the lanes
- All entries in the privilege tariff table shall be non-zero and shall be at least equal to the nominal tariff table entry when no entry is fed into the respective tariff.

3.6 Concession/Incentive Management

Concessions can be managed at TMS level using the privilege and method of payment attributes as described in Section 3.4.

3.7 Weekly and “Time of Day” Tariff Profiles

The tariffs in the tariff table can assume a different value for each day of the week, time of day according to the structure defined in section 3.4.

3.8 Payment Methodology

The toll collection system shall assist in providing the Road User an intuitive facility to direct all Road Users towards the payment of toll for all vehicle types passing through any toll lane. The following is a step-by-step description of the process undertaken by the Users when using the toll facility. The toll collection system should also have facility to process Towed Vehicles and Convoy Vehicles by press of a button on Toll Collector Keyboard.

3.8.1 Lane Types

As a part of the toll collection and management system upgrade process it is proposed to bring some changes in the existing lane types.

An overview of the proposed lane types and the methods of payment is given below:

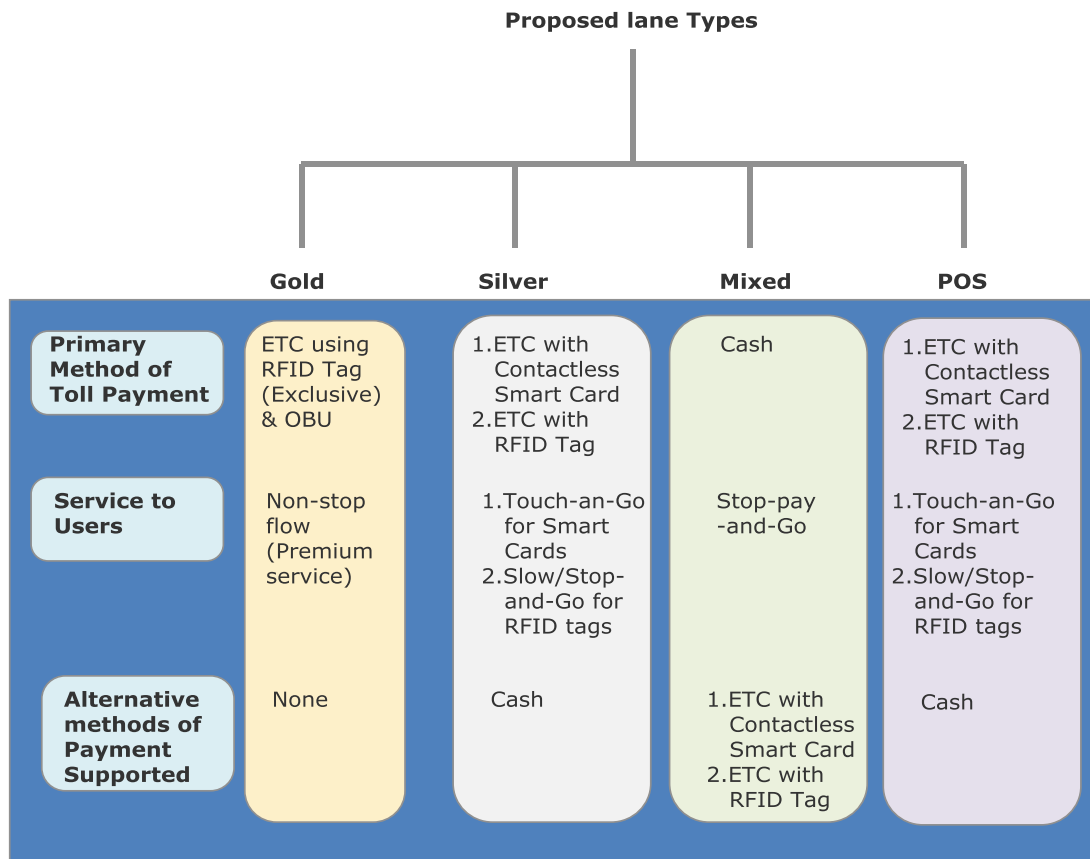
The proposed toll lanes are classified into the following types :

2. **Gold:** The Gold lane will support ‘non-stop’ ETC payment with RFID tags and with OBUs. The use of the Gold lane is offered as a premium service to DND’s customers and thus the RFID-tags meant for the Gold lane will be exclusive i.e. the RFID tags meant for the Silver lanes will not be valid in the Gold lane.

However a valid Gold lane tag will be honoured in the Silver and Mixed lanes.

3. **Silver:** The main function of this lane will be for ETC toll payment using Smart cards and RFID tags. However the basic vehicle movement in this lane will be in the 'Touch-and-go' manner for Smart Cards and 'Slow/Stop-and-go' for RFID tags. i.e. this is not a 'non-stop' lane. Further this lane will also support manual cash payment to handle exceptional situations(e.g. Toll collection by cash from a vehicle with the smart card being detected as invalid) Separate Silver lanes are provided for both 2 wheelers (2W) and 4 wheelers (4W). While Smart cards and RFID tags shall be supported in 4 W Silver lanes only Smart Cards shall be supported in the 2 W Silver lane.
4. **Mixed:** The main function of this type of lane will be for manual cash collection of the toll amount. However this type of lane will also support ETC payment by Smart cards (for both 2 W and 4 W) and RFID-tags (only for 4 W) to handle exceptional situations (e.g. a vehicle with an RFID-tag can use this lane to pay toll if the lane is free from traffic). Mixed lanes are provided separately for 2 wheelers (2 W) and 4 wheelers (4W). For ETC payment the basic vehicle movement in this lane will be in the 'Touch-and-go' manner for Smart Cards and 'Slow/Stop-and-go' for RFID tags. i.e. this is not a 'non-stop' lane.

The details regarding the above lane types and their number are captured in Figure 3.2. below:



Note: ETC Payment in 2 W lanes is only via Smart Card.

S.No	Plaza	Lane Type	Number of lanes
1	DND	4W Gold	2
2	DND	4 W Silver	4
3	DND	4 W Mixed Non-Reversible	10
4	DND	4 W Mixed Reversible	6
5	DND	2W Silver	4
6	DND	2W Mixed	4
7	DND	2/4 Mixed lane (POS lane)	1

Note : Compared to the present system at the DND Plaza, 3 more lanes i.e. Lane numbers 18,19 & 20 shall be reversible i.e. in all lane nos 15,16,17,18,19, 20 shall be reversible lanes

S.No	Plaza	Lane Type	Number of lanes
1	MVL	4W Gold	0
2	MVL	4 W Silver	2
3	MVL	4 W Mixed Non-Reversible	2
4	MVL	4 W Mixed Reversible	2
5	MVL	2W Silver	0
6	MVL	2W Mixed	4
7	MVL	2/4 Mixed lane (POS lane)	1

Fig 3.2: Proposed Lane Types and number

Note on Future Expansion

We are planning to construct 4 additional lanes on DND and 4 additional lanes on MVL. The 4 additional lanes at the DND plaza and the MVL plaza will be constructed at the opposite end of the Toll Plaza canopy that is away from the Toll Plaza Admin building. Thus the proposed toll collection and management system shall have a minimum 25 % additional capacity.

3.8.2 Payment methodology in all Lanes except Two wheeler Lanes

The Users will approach the toll plaza and be guided by means of static traffic signs towards the Gold, Silver & Mixed lanes.

3.8.2.1 Payment in ETC Lanes

3.8.2.1.1 ETC Lane Arrangement

The typical arrangement of the Gold, Silver and Mixed lanes are shown in Figure 3.3 below:

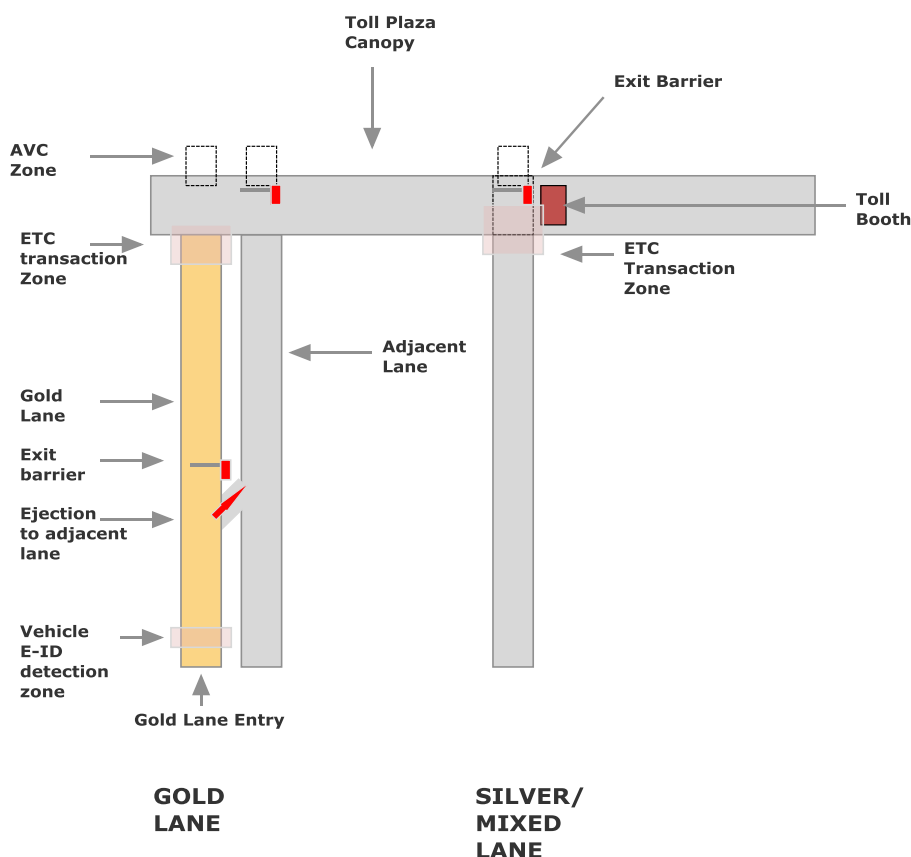


Fig 3.3 Basic arrangement of Gold, Silver and Mixed lanes

3.8.2.1.2 Silver Lanes (and in Mixed lanes as an alternative method of payment)

1. All lanes (Silver or Mixed) that process ETC transactions shall ensure that only the correct vehicle E-ID is detected and processed. The system shall therefore ensure that the E-ID of any following vehicle or vehicles in

adjacent lanes can never be assigned to the current transaction. The bidder shall provide a full description of the vehicle tracking process.

2. Once a valid E-ID has been read, the system shall generate a transaction which will be later processed to debit the User's ETC account for the value of a single passage corresponding to the vehicle class under which the E-ID has been registered. A unique sequential transaction number shall be allocated to each transaction.

A valid E -ID shall be an identifier that:

- is registered on the ETC backend system and appears in the Whitelist
- has not been blacklisted

Note:

- Lack of adequate (based on a pre-defined threshold) positive balance shall result in the ETC backend system automatically blacklisting the ETC account. The reverse shall also happen automatically when the account is adequately re-charged.
- The system shall also allow authorized personnel to manually add or remove the account to/from the blacklist based on other reasons (e.g. directives from law enforcement agencies)

- has not expired
- is not damaged

3. The default position of the exit barrier is CLOSED. On the detection of a valid E-ID and the debit of the corresponding User account, the barrier shall open to let the vehicle leave the lane.
4. Once the vehicle has passed the exit barrier, it will cross the automatic vehicle classification (AVC) system, which shall automatically classify the vehicle according to the defined vehicle classes.

5. The Toll Lane Computer (TLC) shall compare the AVC classification to the registered electronic identifier class, and if different, send a class discrepancy message to the Incidents Computer (IC) located in the toll control room.

Any class discrepancy shall trigger the incident recording system utilising a closed circuit television cameras (CCTV) situated in the lane. While one camera shall adequately capture the image / video (number of images / video time period should be user settable parameters) of the vehicle sufficient to determine its class, the other shall capture an image of its number plate clear enough for human and machine identification.

The above images together with details of the class discrepancy message, corresponding transaction number, date and time of the transaction and lane number for verification by the toll supervision personnel, are captured together thereby completing the transaction. The IC incident resolution system shall in this case allow the option of debiting the value of the discrepancy to the user account.

6. A User fare display (UFD) shall be located on the mainline pay axis. The UFD shall display any pre-programmed message as set by the toll supervisory staff. By default, the UFD shall indicate the applicable toll amount and the remaining balance on the User's ETC account .

In case a vehicle without a valid E-ID (Smart Card or RFID tag) appears in the lane, then the User is expected to pay the toll amount by cash (or other non-ETC methods of payment). The methodology for the same is described in sub-section 3.8.2.2.

3.8.2.1.3 Gold (Express) lane

1. The system in the Gold lane shall ensure that only the correct vehicle E-ID is detected and processed. The system shall therefore ensure

that the E-ID of any following vehicle or vehicles in adjacent lanes can never be assigned to the current transaction. The bidder shall provide a full description of the vehicle tracking process.

2. The ETC Gold (express) lane shall be open to Users at all times except for maintenance periods.
3. The Gold lane is operated along with an eject system to guide vehicles without a valid Gold RFID Tag or OBU to an adjacent lane. This must be carried out in a safe and efficient manner. The system must therefore lead the driver into the lane. The Equipment Supplier shall provide a detailed specification of the mechanism to be supplied for the lead-in system and shall fully describe how the advanced notice to drivers will be given. By way of an example, this could take the form of red and green indicators placed on the approach path of the vehicle. The aspect would normally be green, but would change to red when a vehicle without an E-ID or having an invalid E-ID approaches the indicator. The approaching vehicle would therefore be exposed to a number of warnings, i.e. the red aspect, before the exit barrier is closed to the vehicle's path.
4. If the ETC system does not detect a valid E-ID, the exit barrier will close and eject the vehicle into the adjacent toll lane. The User shall be informed that vehicle must deviate to the adjacent lane by means of a traffic light (red arrow) pointing in the direction of ejection.
5. The system shall detect that the vehicle has successfully passed the vehicle ejection exit point before opening the exit barrier to allow the following (valid) vehicle to pass.
6. A typical toll transaction capture process in the Gold lane shall be as follows:

- a. The ETC system in the Gold lane shall detect the presence of the vehicle upon entry to the Gold (express) lane and shall read the electronic identifier (E-ID) attached to the vehicle.
7. The default position of the exit barrier is open, and upon the detection of a valid identifier, a traffic light (green arrow) shall light and the exit barrier shall remain open to allow the vehicle to pass.

A valid E -ID shall be an identifier that:

- is registered on the ETC backend system and appears in the Whitelist
- has not been blacklisted
 - Note:
 - Lack of adequate (based on a pre-defined threshold) positive balance shall result in the system automatically blacklisting the ETC account. The reverse shall also happen automatically when the account is adequately re-charged.
 - The system shall also allow authorized personnel to manually add or remove the account to/from the blacklist based on other reasons (e.g. directives from law enforcement agencies)
- has not expired
- is not damaged

- a. The Vehicle shall then be allowed to pass through the Gold lane and reach the ETC transaction zone. Here again an E-ID read is performed. Once a valid E-ID has been read, the system shall generate a transaction which will be later processed to debit the User's ETC account for the value of a single passage corresponding to the vehicle class under which the E-ID has been registered. A unique sequential transaction number shall be allocated to each transaction.
- b. Once the vehicle has passed the exit barrier, it shall cross the automatic vehicle classification (AVC) system, which shall automatically classify the vehicle according to the defined vehicle classes.

- c. The Toll Lane Computer (TLC) shall compare the AVC classification to the registered electronic identifier class, and if different, send a class discrepancy message to the Incidents Computer (IC) located in the toll control room.
- 8. Any class discrepancy shall trigger the incident recording system utilising a closed circuit television cameras (CCTV) situated in the lane. While one camera shall adequately capture the image / video (number of images / video time period should be user settable parameters) of the vehicle sufficient to determine its class, the other shall capture an image of its number plate clear enough for human and machine identification.
 - a. The above images together with details of the class discrepancy message, corresponding transaction number, date and time of the transaction and lane number for verification by the toll supervision personnel, are captured together thereby completing the transaction. The IC incident resolution system shall in this case allow the option of debiting the value of the discrepancy to the user account.
 - b. A User fare display (UFD) shall be located on the mainline pay axis. The UFD shall display any pre-programmed message as set by the toll supervisory staff. By default, the UFD shall indicate the applicable toll amount and the remaining balance on the User's ETC account.
- 9. The bidder shall provide full details of the layout of the vehicle ETC Gold (express) lanes, showing the channelling on the approach, the positions of the various items of equipment, as well as the CCTV system and the proposed signage and road markings. Careful consideration shall be given to the channelling and ejection process to ensure that no vehicular collisions will occur with the diversion of vehicle to the Mixed lanes.

3.8.2.2 Cash Collection in Mixed and Silver Lanes

1. An overhead lane sign (OHLS) installed on the leading edge of the canopy roof shall indicate to the User which lanes are open by displaying either a red cross or green arrow.

A traffic light (TL) located in the Mixed lane is red by default to indicate that the User must stop at the tollbooth. The default position of the exit barrier is 'Closed'.

2. The E-ID located on the ETC-paying vehicle shall be read by the ETC system at the approach end of the tollbooth, such that there are no vehicles ahead of the ETC-paying vehicle. If the E-ID is valid, the TL shall turn to green, a buzzer shall sound in the tollbooth to inform the toll collector that an electronic toll collection payment is in progress, the exit barrier shall automatically raise and the system shall generate a transaction which will be later processed to debit the User's account in the ETC Backend system the value of a single passage corresponding to the vehicle class under which the electronic identifier has been registered.
3. If the toll collector had pre-classified the vehicle ahead of the vehicle arriving at the tollbooth, the pre-classification shall be cleared and shall not appear on the toll collector's efficiency report.

The TCT shall be in a ready state for the next transaction. As the vehicle drives out of the lane, it shall cross the automatic vehicle classification (AVC) system, which will automatically classify the vehicle according to the defined vehicle classes. The exit barrier shall then automatically close.

4. The TLC shall compare the AVC classification to the registered electronic identifier class, and if different, send a class discrepancy message to the IC located in the toll control room. A class discrepancy shall trigger the incident recording system utilising CCTV

cameras situated in the lane. While one camera shall adequately capture the image / video (number of images / video time period should be user settable parameters) of the vehicle sufficient to determine its class, the other shall capture an image of its number plate clear enough for human and machine identification.

5. The above images together with details of the class discrepancy message, corresponding transaction number, date and time of the transaction and lane number for verification by the toll super vision personnel, are captured together thereby completing the transaction.
6. If the ETC system does not detect a valid E-ID, the exit barrier will remain closed and the TL shall remain red in anticipation of a manual cash payment.

A message shall appear on the toll collector's display and UFD indicating the reason for non -validity.

At the User's insistence, the toll collector may read the E-ID using a handheld device (barcode reader). The toll collector will attempt to read the identifier, which if successful, will initiate the electronic payment routine as described above. It must be noted that for any payment method for which such a data capture device is used to read the E-ID, the Customer (road-user) details must be recorded with the transaction record. In case this method also fails the toll collector will attempt to enter the E-ID manually into the system by pressing the manual card entry key and keying in the card number via the numeric keypad.

7. If all above attempts to read / enter the E-ID fails the User is then expected pay toll by cash and the methodology for the same is described below:

- a) The toll collector inside the tollbooth will normally visually classify the vehicle as it approaches and stops, and enter the vehicle's classification into the toll lane **computer (TLC) by pressing the appropriate classification key on the toll collector's terminal (TCT) . The correct toll fare shall be calculated based on the toll collector's vehicle class choice** and the applicable toll tariff, and shall be displayed to the User on the user fare display (UFD) and to the toll collector on the TCT. A key to "cancel" a classification incorrectly entered into the TCT shall be available. Use of this key shall be reported and recorded on the **central computer system (CCS) incident record. The toll collector shall also be allowed to cancel a transaction** with the use of this key. This course of action shall trigger a timer that will delay validating the following transaction. The period of delay shall be a settable parameter.
- b) The User fare display (UFD) shall indicate the acceptance of the method of payment, the traffic light shall turn to green and the automatic exit barrier is opened. If the User requests a receipt, the toll collector shall be able to issue a receipt, printed on the receipt printer (RP), by pressing the "receipt" key on the TLC. Receipts shall be numbered sequentially for audit purposes.
- c) Once the vehicle successfully exits the toll lane by passing through the pay axis, the traffic light shall turn to red in anticipation of the next vehicle.. The exit barrier shall then automatically close.
- d) The vehicle shall be classified by the AVC as it exits the lane. The TLC shall compare the AVC classification to the registered electronic identifier class, and if different, send a class discrepancy message to the IC located in the toll control room. A class discrepancy shall trigger the incident recording system utilising a CCTV cameras situated in the lane. While one camera

shall adequately capture the image / video (number of images / video time period should be user settable parameters) of the vehicle sufficient to determine its class, the other shall capture an image of its number plate clear enough for human and machine identification.

- e) The above images together with details of the class discrepancy message, corresponding transaction number, date and time of the transaction and lane number for verification by the toll supervision personnel, are captured together thereby completing the transaction.
 - f) In case the toll collector is found to have erred in his / her classification, there shall be a provision to debit his / her account during a supervisor audit.
 - g) The AVC processor shall retain the standalone functionality in the event of a communication failure with the TLC and will thus independently store details of all vehicles that were classified
 - h) The completed passage across the counting system indicates the end of the transaction to the TLC. The system should be in a ready state for the next transaction after acceptance of the MOP for the previous transaction.
8. Along with a Single journey Toll fare the system shall also support a Return journey Toll Fare. In case the Customer (road-user) wishes to avail of the Return journey Pass the system shall issue a Toll receipt for a value equal to two single journeys and having an appropriate barcode printed on it. When the Customer returns to the Toll Plaza the system shall scan this barcode (when the above receipt is presented to the Toll collector) and if found valid, shall allow the vehicle to proceed by opening the exit barrier.

9. The applicable toll tariffs and blacklists list shall be available on the TLC at all times.

3.8.3 Two-wheeler Lanes

Two-wheelers will be directed towards the dedicated two-wheeler lanes by means of road marking and static traffic signs. The software shall consist of a common generic system configurable to suit the requirements of all toll lanes. The functionality of the two-wheeler lane shall be selected by the specific configuration and lane initialisation. Two-wheeler lanes can only process one class and the system shall allow for a default class for each transaction.

3.8.3.1 Payment in Two-wheeler ETC lanes

1. The two-wheeler ETC Silver lanes shall be open to Users at all times. The default position of the exit barrier is Closed. The ETC system shall detect the presence of the two-wheeler upon entering the Silver lane and shall read the Smart Card presented to the reader (Touch-and-Go). Upon the detection of a valid identifier, a traffic light (green arrow) shall light and the exit barrier shall open to allow the two-wheeler to pass through the ETC lane pay axis, which is located at the exit barrier.
2. Once the two-wheeler has passed through the Silver lane pay axis, the system shall generate an ETC transaction which will be processed later to debit the User's account the value of a single passage corresponding to the vehicle class under which the E-ID has been registered. The barrier shall now CLOSE. The two-wheeler shall be counted and classified in the lane by an AVC at a position past the exit barrier to complete the transaction.
3. The TLC shall compare the AVC classification to the registered electronic identifier class, and if different, send a class discrepancy message to the IC located in the toll control room. A class discrepancy shall trigger the incident recording system utilising a CCTV camera situated in the lane. The camera shall record a digital image or a short

video of the vehicle together with details of the class discrepancy message, corresponding transaction number, date and time of transaction, lane number and toll collector for verification by the toll supervision personnel, thereby completing the transaction.

4. If the ETC system detects a valid E-ID, the exit barrier will open. Else the two-wheeler will be manually guided into the adjacent Mixed toll lane. The User must be informed that two-wheeler must deviate to the adjacent lane by means of a traffic light (red arrow) pointing in the direction of ejection. The system shall detect that the two-wheeler has successfully passed the two-wheeler ejection point before opening the exit barrier to allow the following two-wheeler to pass.
5. A User Fare Display (UFD) shall be located on the mainline pay axis. The UFD shall display any pre-programmed message as set by the toll supervisory staff. By default, the UFD shall indicate the applicable toll amount and the remaining balance on the User's ETC account.
6. The bidder shall provide full details of the layout of the two-wheeler ETC lanes, showing the channelling on the approach, the positions of the various items of equipment, as well as the proposed signage and road markings. Careful consideration shall be given to the channelling and ejection process to ensure that no vehicular collisions will occur with the diversion of two-wheeler to the Mixed lanes

3.8.3.2 Cash Collection in Two-wheeler Lanes

1. Cash collection is primarily performed in 2 Wheeler Mixed lanes and as an alternative method of payment in Silver lanes
2. Two-wheeler Mixed lanes will be made available for cash collection by manually removing access prohibition signs (e.g. water-filled barriers) at the entrance to the lane, at the toll island ends.

3. A traffic light (TL) located in the manual lane is red by default to indicate that the User must stop at the tollbooth.
4. The process of Cash collection is resorted to in a Mixed lane when an arriving vehicle has no valid E-ID (i.e. No Smart card or invalid E-ID on Smart Card). Therefore the first step is to attempt to read the E-ID of an arriving vehicle.
5. The E-ID (carried in a Smart Card) located on the ETC-paying two Wheeler shall be read by the ETC system (using a Touch-and-Go Smart Card reader) at the approach end of the tollbooth. If the E-ID is valid, the TL shall turn to green, a buzzer shall sound in the tollbooth to inform the toll collector that an electronic toll collection payment is in progress, the exit barrier shall automatically rise and the system shall generate an ETC transaction that shall be processed later to debit the User's account the value of a single passage corresponding to the vehicle class under which the electronic identifier has been registered.
6. The TCT shall be in a ready state for the next transaction. As the two Wheeler drives out of the lane, it shall cross the automatic vehicle classification (AVC) system, which will automatically classify the vehicle according to the defined vehicle classes. The exit barrier shall then automatically close.
7. The TLC shall compare the AVC classification to the registered electronic identifier class, and if different, send a class discrepancy message to the IC located in the toll control room. A class discrepancy shall trigger the incident recording system utilising a CCTV camera situated in the lane. The camera shall record a digital image or a short video of the vehicle together with details of the class discrepancy message, corresponding transaction number, date and time of transaction, lane number and toll collector for verification by the toll supervision personnel, thereby completing the transaction.

8. If the ETC system does not detect a valid E-ID, the exit barrier will remain closed and the TL shall remain red in anticipation of a manual payment

A message shall appear on the toll collector's display and UFD indicating the reason for non -validity.

At the User's insistence, the toll collector may read the E-ID using a handheld device (barcode reader). The toll collector will attempt to read the identifier, which if successful, will initiate the electronic payment routine as described above. It must be noted that for any payment method that such a data capture device is used to read the E-ID the Customer (road-user) details must be recorded with the transaction record. If the card is unreadable, the card number may be entered manually into the TLC by pressing the manual card entry key and keying in the card number via the numeric keypad.

9. If all above attempts to read / enter the E-ID fail the User is then expected pay toll by cash and the methodology for the same is described below:
10. The toll collector inside the tollbooth would have visually classified the vehicle as it approached and enter the vehicle's classification into the toll lane computer (TLC) by pressing the appropriate classification key on the toll collector's terminal (TCT). In the two-wheeler lanes, this should only be the class corresponding to a two-wheeler. The TCT should however be compatible and interchangeable with any TCT used in the vehicle lanes.
11. The applicable toll tariffs and blacklists shall be available on the TLC at all times.

12. The toll collector's display in front of the toll collector as well as the User fare display (UFD) unit, installed in full view of the User, shall indicate the vehicle class and applicable toll tariff.
13. Once the User has tendered the toll due, the toll collector accepts the fare and validates the transaction by pressing the button indicating the MOP received.
14. The User fare display (UFD) shall indicate the acceptance of the method of payment, the traffic light shall turn to green and the automatic exit barrier is opened. If the User requests a receipt, the toll collector shall be able to issue a receipt, printed on the receipt printer (RP), by pressing the "receipt" key on the TLC. Receipts shall be numbered sequentially for audit purposes.
15. Once the two-wheeler successfully exits the toll lane by passing through the pay axis, the traffic light shall turn to red in anticipation of the next two-wheeler. The exit barrier shall then automatically close.
16. An AVC automatically counts and classifies the vehicle.
17. The TLC shall compare the AVC classification to the toll collector class, and if different, send a class discrepancy message to the IC located in the toll control room. A class discrepancy shall trigger the incident recording system utilising a CCTV camera situated in the lane. The camera shall record a digital image or a short video of the vehicle together with details of the class discrepancy message, corresponding transaction number, date and time of transaction, lane number and toll collector for verification by the toll supervision personnel, thereby completing the transaction.
18. In case the toll collector is found to have erred in his / her classification, there shall be a provision to debit his / her account during a supervisor audit.

19. The completed passage across the counting system indicates the end of the transaction to the TLC. The system should be in a ready state for the next transaction after acceptance of the MOP for the previous transaction.
20. Along with a Single Journey Toll fare the system shall also support a Return Journey Toll Fare. In case the Customer (road-user) wishes to avail of the Return Journey Pass the system shall issue a Toll receipt for a value equal to two single journeys and having an appropriate bar code printed on it. When the Customer returns to the Toll Plaza the system shall scan this bar code (when the above receipt is presented to the Toll collector) and if found valid, shall allow the vehicle to proceed by opening the exit barrier.
21. The applicable toll tariffs and blacklists list shall be available on the TLC at all times.
22. The system shall also support payment of toll using Credit Card. For this purpose each lane shall have a PCI Data Standards compliant credit card terminal interfaced to the TLC (in hardware and software). More details are provided in section 4.15.

3.8.4 Collection of MCD entry tax

1. Along with Toll Collection, MCD entry tax shall be collected in all Mixed and Silver lanes, from commercial vehicles entering the city of Delhi. Thus this feature shall be activated in lanes in the main DND plaza that are directed towards Delhi.
2. As the vehicle enters the Mixed lane, the collector, on noticing that it is a commercial vehicle (and aided by an alert from the LPR Image capture camera on detecting a yellow number plate) , will pre-classify the vehicle once for toll and once for MCD. On the TCT screen the operator selected class will appear at 2 locations:

- i. as per the toll collection vehicle classification and
 - ii. as per the MCD Classification.
3. In case the vehicle possesses a MCD Pass for the entry tax the toll collector will press an 'MCD Pass' key and input the unique reference number of the pass. IN this case the MCD entry tax will not be collected from the vehicle.
4. The total amount is then received from the vehicle, a common receipt (i.e sequential receipts) handed over along with the change.
5. Barrier opens and the Vehicle moves out.
6. The AVC classifies a Class for Toll and a Class for MCD.
7. The system facilitates (similar to Toll Collection) an audit of transaction for under or over classification as well as an Exempt in case of the presence of an MCD Pass.
8. The AVC supported by an Image capture and interpretation system that can detect the yellow License Plate of the commercial vehicle shall also aid in the audit.
9. Cash up declaration shall be common for DND Toll and MCD Toll (in terms of data entry into the screen). A common Debit / Excess for both shall be displayed accordingly on the terminal / reports.
10. The following reports related to MCD entry tax collection shall be generated:
 - i. End of shift report,
 - ii. Daily Collection,
 - iii. Traffic: Class-wise

ETC shall be supported for MCD entry tax collection only for MCD Vehicle Class I (which is also DND Toll Class II). Such vehicles can also pay their MCD entry tax in Silver lanes (& mixed lanes) using their NTBCL-issued Smart Card / RFID tag meant for toll collection. The E-ID shall be common for both toll collection and MCD entry tax payment. The facility of ETC mode of payment will not be extended to vehicles possessing an MCD Pass.

3.8.5 Point of Sales

3.8.5.1 Payment for Passage at the POS lane (bypass)

The point of sales lane (bypass) shall be fitted with a fully functioning mixed toll collection system. The AVC shall be capable of classifying all vehicles including two-wheelers. The passage processes shall be as described under corresponding items in the sections above.

3.8.5.2 ETC Sales at the POS

POS ETC sales and administration functionality is discussed in Chapter 5.

3.8.6 Lane Communication

If required, the toll collector can communicate to the control room via an intercom installed in the tollbooth or if a dangerous situation occurs, via the hands free panic switch which shall cause an alarm to be sounded in the control room.

3.8.7 Manual Booth Controller

If a TLC fails, the collector can control the traffic through the lane with the manual booth controller (MBC). The MBC shall enable the collector to manually control the overhead lane sign, the exit barrier and the traffic light. For this purpose the MBC shall be independently powered and shall not derive its power from the TLC.

3.9 Other Payment Process

3.9.1 Exempt Passage Process

The toll collector shall press the Exempt Passage key when such is being used as the MOP. Options appear on Screen Viz.,. Police, Ambulance, Fire and VIP for the toll collector to select. An exempt transaction shall be treated as a violation transaction in that the vehicle and License plate images / video is captured, reviewed and validated by a competent authority. The toll collector shall be enabled to enter key details about the vehicle and User before completing the Exempt Transaction.

3.9.2 Crediting ETC Account

All lanes shall have the facility to accept ETC account deposits. However certain lanes shall be designated for performing this function during the lane initialization process. A “Credit ETC Account” key shall be made available for this process. The software shall be designed to guide the toll collector through this process. Only Cash and Credit Card Payments will be accepted. In case the payment is made by Credit Card the corresponding details will be entered by the Toll collector and the system shall support the same. The details will be provided to the successful bidder during the system design phase.

3.9.3 Towed or Continuous Vehicle Processing

1. Towed transaction does not necessarily mean that there shall be only one towed vehicle. There shall be any number of vehicles towed together by any means. Even if vehicles are not towed, in certain exceptional cases multiple vehicles moving as part of same fleet shall be processed together with the same procedure defined below.
2. User of the towing vehicle selects an open lane and is directed to an appropriate lane by canopy (OHLS) signs. At the payment axis the vehicle is stopped by a traffic light (red aspect). Toll collector enters into Towed mode by pressing a dedicated “Towed Key” and enters vehicle class of all the vehicles to be processed as part of towed mode. After classifying each

vehicle, the Toll Collector confirms by “Enter Key” and then keeps entering the class of the subsequent vehicles followed by “Enter Key” into toll collector’s terminal one by one, this action adds the toll amount payable for all vehicles together based on the single trip nominal fare. The toll collector then receives the money from the User. If necessary, toll collector gives the change back and presses the “Cash Key” to confirm the method of payment. If required, it is possible to print a receipt by pressing the “Receipt Key”. After confirming the method of payment, the exit barrier gets opened, traffic light turns to green from red and the User leaves the toll lane. In no circumstance the barrier arm shall fall over any of the vehicles. The incident capture camera shall be triggered in this situation to capture the video from the start of Towed Mode to the end of Towed mode and the grabs shall be sent to the supervisory level for further action. As soon as the last vehicle clears the lane the toll collector will again press the “Towed key” to confirm end of transaction. The Traffic light is reset to red and barrier gate closes, as soon as the toll collector presses the “Towed key”.

3. Any time before MOP validation during transaction process, if the toll collector realises that he/she has misclassified any of the vehicle, he/she shall be able to cancel the previous action by pressing “Cancel Key” of the TCT console and continue with the transaction, an incident message shall be sent to TMS and LSDU. Under any circumstances, the toll collector shall not be able to Cancel a transaction after validation of MOP.

3.9.4 Processing of Convoy

1. In this case a separate lane shall be assigned to process convoy transaction, depending upon the traffic volume and type at the plaza at the time of convoy processing. The toll collector will receive the instruction from his superior just before the convoy expected time of arrival that a special lane shall be opened or cleared, if already processing traffic. As soon as the convoy arrives at lane, the toll collector will press the “Convoy Key” of the TCT, this action shall turn the traffic light to show green aspect, exit barrier gate opened. Since the toll collector is not entering the

class of the vehicle, so all the vehicles shall be processed as Violation transaction and a violation receipt shall automatically be printed for each vehicle. Violation alarm shall not be activated if the convoy key is pressed. All transactions with their associated incidents and image / video grab during the Convoy Mode shall be sent to the supervisory level for further action. Under no circumstances, the barrier arm shall fall over any of the vehicle of the convoy. As soon as the last vehicle of the convoy leaves the lane, the toll collector will then again press the Convoy key to turn the traffic light to show red aspect and to close the exit barrier gate. At this time the collector can classify the next vehicle.

2. All transactions linked to Convoy Mode shall be treated as Violations except that only Confirm and Reject Options shall be available during incident correction (In other Violations → Run through, Ignore, Paid options also shall be available).

3.9.5 Additional requirements for Toll Technology

1. **Interoperability:-** The system shall lend itself for interfacing with other interoperable CONCESSIONAIRES like Yamuna Expressway, Delhi Gurgaon Expressway, Badarapur Flyway and NHAI in future. This essentially involves the following
 - Ability to periodically download blacklists / whitelists (along with the balance amounts in the individual ETC accounts) of Electronic Identifiers of Tags / Smart cards of such programs via the ETC Client (belonging to Part A) from their respective Clearinghouse(s) and hold them (in the ETC Client). .
 - Ability to read the tags / Smart cards from vehicles participating in such programs and generate transactions (as per the respective program's format) in the lanes

- Ability to classify vehicles as per the respective vehicle classes, generate misclassification and other violations and allow audit at the local plaza
- Ability to gather all transactions related to a particular program, send them periodically to the respective Clearinghouse as claim for payment. While clean (non-violation) transactions shall be sent as they are, the violation (mis-classification) transactions shall be sent with supporting vehicle images.
- Generation of program-specific reports like Revenue Recognized, Revenue claims, Transactions confirmed / rejected / still to be confirmed, Payment received etc.

It is essential that the upgrade toll system be of suitable architecture and capacity to be open for the inclusion of above interoperability programs.

2. **Support other methods of payment:-** The system, with its open architecture, shall lend itself to interface other modes of payment like Near Field Communication (NFC), QR Code, Video Tolling, other possible methods using the mobile phone etc.
3. **Back Office support:-** The System provided shall support all of the back office activities associated with electronic toll collection such as Customer account management, website services, financial management, transactions processing, reconciliations, invoice processing and violations processing. The Contractor shall ensure back office system maintainability, accuracy, reliability, security, and availability over the term of the Contract. The System shall support DND operations over the life of the project and process up to 250,000 transactions per day.

4. **Data and Financial Security, Integrity, and Accountability:-**
Appropriate security measures shall be implemented and demonstrated to the satisfaction of NTBCL to assure the integrity of NTBCL's data and policies.

5. **Data loss:-** The System shall be designed to protect against data loss caused by equipment malfunction and failure, inadequate data storage capacity, communication loss, power outage, voltage drop or surges, extreme temperatures, deletion by unqualified and unauthorized users, or software attacks (i.e. rogue users/hackers, virus attacks, etc.). The System shall employ an integrated and comprehensive anti-spam and anti-virus protection system.

The System shall support the daily reconciliation of changes in account balances resulting from the opening of an account with the required deposits, the closing of an account involving the refund of the outstanding balance and deposit, account replenishments and payments posted to the account, the posting of toll transactions, adjustments, and assessment of fees. Like the current practice, the customer care centre shall accept cash in addition to credit cards, debit cards to establish an initial account balance or to make a payment on an account.

6. **Customer accounts:-** The system shall enable to maintain all Customer accounts. The System shall require each account to have a unique account number, PIN, username, and password. The System shall integrate standard industry protocol into the PIN, username, and password issuance, management, and usage.
7. **Emails/sms:-** The system shall have the capability to communicate with customer by way of SMS or e-mail in the following events:- Transaction posted to account (Toll, Adjustments, Fee etc.), Low balance threshold reached and Receipt of Payment. The system should keep track of all the documents that are exchanged between the customer and DND.

8. **Website:-** The agency shall design, develop, implement, manage, and maintain the DND website. In addition, authorized DND staff shall be able to independently and directly update the website by way of a Web Content Management System. The website shall provide Customer access to account information through a secure login. The website shall include prominent links for contact information, privacy policy, opening an account, accessing an account, registering retail Toll Tag, paying or disputing a toll or toll violation, and FAQs. The website shall display and function properly on various types of Web-enabled mobile devices, including tablets, smart phones, etc. The website shall provide services to allow account holders to, at a minimum, do the following upon logging into their account. Submit Account application , View and Update Account Information, Request/Change Password/Change PIN/Retrieve forgot Password, Make Payment and Obtain receipt, Print Statement/Download Usage / Transaction data
9. **Inventory Management:-** The System shall provide RFID Tag/ OBU / smart cards inventory management functionality and shall manage all aspects of the RFID Tag inventory. The System shall track RFID Tag / OBU / smart card inventory from the issuance of a purchase order through the life of the RFID Tag / OBU / smart card.
10. The System shall receive and process all transactions sent to the back office from both DND and MVL Plazas. The System shall process files containing RFID Tag, OBU and smart card transaction records received from the lane by posting this data to an appropriate inventory account.
11. **Reporting:-** The system shall provide all reports that are necessary for the operation, monitoring, evaluating, documenting, reconciling, and reporting of the DND. The Contractor may provide an off-the-shelf, integrated reporting (or business intelligence) system as the primary reporting interface. The reporting system shall provide users with intuitive, self-service access to query and reporting capabilities. The reporting system shall use the System's user role-based security features. The reporting

system shall allow an authorized user to access various content types, including pre-defined reports and structured and unstructured content based on their user role.

12. **Training:-** The Contractor shall be responsible for providing the training for DND staff for the efficient operations of new toll technology. The agency shall present a training plan to DND prior to implementation of the System. DND may review the training plan and reserves the right to request modifications to the plan. The plan shall detail the training topics, schedule and training tools for each training phase by staff role.

4 Equipment Operational Requirements

4.1 General guidelines

1. The in-lane equipment of NTBCL refers to Vehicle detection classification devices such as Treadles, loop, vehicle separators, profile identifiers, height sensors, ETC antenna and receivers. In addition they include surveillance, traffic control devices, toll payment indicators
2. The features of various equipment and Toll Management are listed with the current practice as well as expected operational and technical requirements. All description in this section of this document is indicative only. The bidder shall ensure that all necessary features mentioned in this section as well as modern and state-of-the-art tolling practices in the world shall be implemented and customized to suit all conditions of NTBCL.
3. All equipments shall have built in or external surge protection devices. The bidder shall ensure that all consumable items used on any of the TCE are available in India.
4. The bidder shall provide a list of recommended specialist equipment with individual prices per item, required to test or repair any aspect of the toll collection system. Upon approval of such a list, the Equipment supplier shall supply the specialist equipment to the Operator at the tendered rates. Preference would be to source specialist equipment from India to the extent possible.
5. The UPS shall be designed for 125% of the total connected load. The power supply to all electronics equipment (Indoor & outdoor) shall be fed from UPS which shall have minimum 30 minutes backup. UPS shall be of Industrial Grade.
 - a) A dedicated UPS for each and every TLC shall be provided and shall be located in the tunnel

- b) In addition a separate UPS shall be provided for each and every AVC system and shall be located in the tunnel
 - c) A dedicated UPS for servers shall be provided. It shall be a hot-standby system for each server rack with hot swappable modules.
 - d) A common UPS shall be provided to power up back-office workstations and other equipment not covered above. This shall be suitably located in the Toll Administration building of each plaza.
6. TLC/ALC Operating System shall be standard OS available of the shelf that is widely used and has adequate support. Operating system should be capable of being migrated to a new higher version once the version currently proposed is withdrawn by the OS provider
7. All the equipment, Operating System and Database to be supplied shall be transferred in the name of NTBCL and not the bidder or equipment vendor. Operating System and Database should be Paper License and not OEM License.
8. All electrical as well as electronic equipment must carry a warranty of 2 years from the date of installation.
9. The TLC / AVC equipment across all lanes, whether Mixed, Silver or Gold lanes should be uniform and consistent
10. Equipment and equipment installation shall comply with the latest revision of the applicable Bureau of Indian Standards (BIS) standards. Where no BIS standards exist for any aspect of equipment manufacture, supply, installation, identification, protection, testing or operation, then the relevant IEC or ISO standard shall apply. CEN or CENELEC standards shall apply where no BIS, ISO or IEC standards exist. In particular, the equipment supplier and installer of all equipment shall comply with the standards set by the following division councils of the BIS:

- Basic and Production Engineering Division Council (BPDC)
- Civil Engineering Division Council (CEDC)
- Electro technical Division Council (ETDC)
- Electronics and Telecommunications Division Council (LTDC)
- Transport Engineering Division Council (TEDC)

The bidder shall clearly indicate in the bid, the corresponding standard the equipment conforms to.

4.2 Operating Temperature

1. The equipment to be supplied will be able to operate under the following environmental conditions unless specified otherwise :
 - Minimum temperature: -10 degree C
 - Maximum temperature: +65 degree C
 - At relative humidity: up to 95%
 - Vibration frequency range: 10Hz to 55HZ
2. Should the equipment be unable to function in these conditions, protection or device to regulate the equipment-operating environment shall be provided. The temperature range that is specified is the ambient temperature, which is defined as the temperature of the surrounding atmosphere as determined by an instrument shielded from direct or reflected rays of the sun.

4.3 Toll Lane Computer (TLC)

The following describes the functional requirements of the TLC, its modes of operation and the equipment enclosure.

4.3.1 Description and Functions

1. The toll lane computer (TLC) is situated in the service tunnel under the toll booth and has the principle task of controlling the toll collection function, transmitting information and data on all lane activities to a central computer system (CCS) and receiving other control information and data from the CCS. It also has the function of controlling all other peripheral equipment connected to it.
2. All hardware, software, TLC interface to peripherals and peripherals controllers and CCS shall be supplied by the equipment supplier.
3. The TLC software shall be developed to operate any of the types of toll lanes defined in the project. The software shall be easily configured to activate the specific requirements for special-purpose lanes, such as two-wheeler lanes and Gold (express) lanes.
4. All lane operating data shall be stored on the local hard disk drive in the lane. “Thrashing” of the hard disk drive shall be prevented. The TLC shall have enough memory to load and maintain all necessary programmes tables and data in memory, to optimise the toll collection functionality. All other financial and transaction data shall be stored on the local hard drive of the TLC before being transmitted to the CCS.
5. The following minimum information is to be stored:
 - i. Transactions
 - ii. Tariff Tables (active and pending)

The TLC shall refer ‘on-line’ to the ETC Client which shall hold the current white (along with the balance amount in the ETC account) and black lists to verify whether the E-ID of a Card/ Tag / OBU just read is valid or blacklisted. In case of a link failure there shall be a provision to download the above lists on the TLC.

Note: During operation when the link with the ETC Client is broken the UFD shall not display the balance amount in the user account.

6. The Equipment Supplier shall submit details of the data types utilised for the system. A transaction record shall contain all the necessary information to enable complete control and auditing of the system.
7. All lane peripherals shall be integrated with TLC. The TLC shall be capable of interfacing with at least the following peripheral equipment:
 - Toll Collector Terminal
 - Credit Card terminal
 - Biometric reader
 - Barcode reader
 - Lane Receipt Printer
 - User Fare Display
 - Traffic Light
 - Overhead Lane Sign
 - Fog Light
 - Manual Booth Controller
 - Central computer system
 - Lane AVC system
 - Lane Exit Barrier
 - Incident Capture CCTV Camera
 - License Plate Camera
 - Electronic Toll Collection Equipment
 - Violation Recording (CCTV) System
 - Panic Switch & Violation Alarm
 - RFID reader
8. The TLC shall further allow for interfacing via three additional (spare) high-speed serial USB devices. The TLC shall be capable of communicating with the CCS. Communication shall consist of data necessary to build a complete database in the CCS, from which the required financial and operating reports and statistics can be produced.

9. The CCS shall also receive and log any reportable incidents occurring in the lane, which shall be transmitted real-time to the Incidents computer (IC) for action by the toll supervision staff. In terms of incidents, real-time shall mean the time from the occurrence of the incident to the storage of the incident on the LSDU and the subsequent printing of the incident on the display, shall not be greater than 10 milliseconds.
10. As described above, all data entities shall be sequentially numbered and referenced to other related entities. The incidents that occur during a transaction shall refer to the transaction.
11. Transactions and incidents shall refer to the applicable financial entity in which they occur.
12. An automatic/manual data validation process is required to check for data continuity and missing/duplicate data. An audit trail of manual corrections is required. The data validation process shall be linked to a “data not complete” message that will be indicated on reports if data is missing. The following is the minimum requirements for this automatic/manual validation process, but the bidder shall submit the full details on how the data validation, verification and recovery procedures will function in the automatic and manual cases.
13. The automatic data validation and completeness process shall constantly monitor the sequence of all data types received by the CCS to ensure that no gaps occur in the sequence numbering. Any detected gaps shall be immediately reported to LSDU. The system shall initiate its data recovery process by automatically interrogating the data source to search and find the missing data. If the system fails to automatically restore the missing data, it shall immediately notify the operator of the condition and shall identify the nature of the data void and prompt the user as to the proposed actions to follow to restore the data.

14. The TLC shall also be capable of receiving messages from the CCS. These messages will contain data on the tariff tables, tag / OBU / card blacklists, , etc. Should the link between the TLC and the CCS be inoperative, a system to download such information locally into either computer is to be available. Similarly in case of a failure of the link between the TLC and the ETC Client a system to download information such as the current white lists and black lists into the TLC is to be made available.
15. The TLC (via the AVC) shall monitor the lane at all times for any traffic violation or incident, and for failure of any of the toll equipment. The level of incident reported to the toll collector via the peripherals in the tollbooth, or reported to the IC shall be a parameter setting in the software available at a definable level. Similarly, the peripheral(s) (receipt printer, toll collection terminal, toll collector's display, audible alarm) that will communicate the incident/violation report to the toll collector shall be a settable software parameter.
16. When in local mode, i.e. communication between the CCS and a TLC is absent, data for all transactions shall be capable of being transferred to or from the CCS via a USB data drive
17. Extended operation of the TLC when the CCS is off-line must be possible (Local Mode). The system shall manage its data storage capacity to ensure adequate free space for the operating system, application and database. The system shall provide warnings as to free-space when the storage capacity reduces to critical limits. The bidder shall provide the details on the systems data management strategy. If the data storage on the TLC reaches its critical limit, it shall prevent further processing of traffic and shall prevent further logons to the system. It shall prompt the toll collector to inform the supervisory staffs to initiate a data extract procedure.

18. The TLC shall be capable of producing a printed report in the lanes (mini-shift) for each period worked (each login to logout period). The report shall contain the information as described under sections 5.10 & 6.2.
19. Time throughout the entire toll collection system shall be synchronised by reference to the CCS.
20. All data stored in TLC hard disk should be in an encrypted form, not available to any user to be decrypted. However, the Supervisor of the system must have an option to convert the entire lane data in the form of a TXT or CSV format.

4.3.1.1 TLC modes

The TLC shall operate in the following modes:

- a) Idle Mode
- b) Open Mode
- c) Fault Mode
- d) Maintenance Mode

Different functions shall be accessible in each mode. The state of the lane peripheral equipment shall also change according to the mode. Each mode is described in more detail below:

(a) Idle Mode

This mode is the lane's normal resting state. A null toll collector is assigned to the lane by default on power-up or on log -out by a toll collector. All incidents and transactions are assigned to the null toll collector whilst the lane is in idle mode.

In idle mode the lane peripherals are in the following state:

The TCT visual display unit displays the time, date, lane number and a message prompting the user to login.

- The OHLS and Traffic light red elements are displayed
- The UFD is blank
- The AVC is idle
- Receipt and transmittal of data from or to the CCS
- The TLC is enabled to process violations

The functions available from this mode are:

- Shutdown
- Monitoring of all peripherals
- Log-on

(b) Open Mode:

This mode is the lane's normal state when a toll collector has logged-in and the lane is available for the processing of traffic.

In open mode the lane peripherals are in the following states, which will change as the toll transaction proceeds:

The TCT VDU displays the time, date, lane number, toll collector identification and a message prompting the toll collector to enter the next part of the transaction.

- The OHLS green arrow is displayed when the lane is open or red whilst in the process of opening or closing, or processing a queue
- The traffic light is active
- The UFD is active
- The AVC is active
- The TLC is enabled to process transactions.

The functions available from this mode are:

- The processing of all types of toll transactions
- Control and monitoring of all peripherals
- Log-off

(c) Fault Mode:

This mode is entered when the TLC detects a peripheral device fault. The first action taken by the TLC is to report the fault type to the Lane Status Display Unit (LSDU) and to display the fault message on the TCT display if set to do so. Subsequent action depends on the peripheral equipment that has faulted.

(d) Maintenance Mode:

1. The TLS enters into maintenance mode when a maintenance ID is used to login. This activates certain functions and reporting in the equipment reserved solely for maintenance and upgrading purposes, and allows simulation of certain toll collection functions and operations.
2. In maintenance mode the lane peripherals are all active and allow manual and automatic control in a manner similar to that in open mode. The only exception is the OHLS, which is set to the red element (closed) regardless of the state of the TLC and TCT, so that Users do not see the lane as open whilst it is being maintained. Provision however must be made to toggle the OHLS from red to green for short periods of time to test the aspects of the device.
3. During maintenance mode operations, all data shall continue to be transmitted to the CCS but these will be flagged so that they are not integrated into the traffic and income reporting. Any vehicular passages processed while in maintenance mode shall not have a financial consequence, i.e. credit card and ETC transactions shall

not be processed for debit to a user account. Any traffic processed shall not be included into the traffic count records.

4. All transactions shall identify the method of concluding the transaction, i.e. via the simulation key and the actual AVC. The system shall be capable of generating mini-shifts for maintenance mode as well as listing the details of all transactions for methods of payment other than cash.
5. The functions available from this mode are:
 - Control and monitoring of all peripherals
 - Special functions
 - Log-off

4.3.2 General Requirements

1. The TLC / AVC equipment across all lanes, whether Gold Lane , Silver Lane or Mixed Lane should be uniform and consistent
2. The TLC / AVC application shall be consistent and standard across all the above types of lanes and should be configurable to specify the type of lane and the sensors that would be connected for each of them
3. The TLC/ALC OS should preferably be hardened OS that would only allow the most essential TLC / AVC application and related equipment to function and completely restrict access or running of any other services or processes
4. TLC/AVC shall have adequate physical security at an individual PC level to ensure protection against any malicious intent
5. The TLC/AVC OS and application shall support contemporary serial port hardware cards for easy connection of serial devices

6. The TLC / AVC application shall interface with various types and makes / models of sensors and lane equipment that would be available in the market
7. The TLC / AVC application shall have adequate flexibility and conform to standards to enable integration with new technologies
8. The TLC / AVC shall be completely capable of operating in a stand-alone mode to circumvent outage due to any network failure
9. The online transactions generated by TLC/AVC shall be stored in an encrypted / encoded format and should have adequate complexities and protection to ensure that the integrity of the data cannot be compromised by a malicious attacker
10. In the event that the above information is being stored on the TLC / AVC in a database, the database has to be an extremely lightweight one, with very limited requirements and overheads on the system. The interoperability of such a database with a hardened OS must be established
11. In the event of a database being used at a TLC / AVC, the security of the database, the licensing cost of the same, encryption / encoding of the same and regular housekeeping of the same to be provided in detail separately
12. The local data storage format (file or database) at the TLC / AVC would have to be for a minimum of 3 – 6 months
13. The communication of the TLC / AVC with the central TMS system should be on a secure channel and should have adequate encoding / encryption to guard against online tampering of the data
14. In an integrated mode (TLC / AVC connected with the CCS/TMS)
 - a. every new transaction created at the TLC / AVC should be transferred to the TMS as close to real-time as possible

- b. flow of information from TMS to TLC (, tariff tables etc) should be as close to real-time as possible but should not exceed 10 minutes
 - c. Verification of an EID in the white / Black list stored by the ETC client shall be instantaneous.
- 15. There should be a provision for taking regular backup of the TLC / AVC transaction data. This process should be completely independent of the TMS system and the backed up data should also reside on a different system than the TMS
- 16. The TLC / AVC should be capable of communicating with the central servers over a pre-defined set of ports across a firewall

4.3.3 TLC Housing Requirements

The TLC and all related peripheral controllers should be enclosed in an IP54 or similar compliant cabinet.

- 1. Locking System: Each cabinet shall have a unique key allowing access to the TLC and AVC.
- 2. Door monitoring: The cabinet door shall be monitored utilising proximity switched. Door open / close events shall be recorded as incidents identified by time and TLS identification. Indicative incidents that are to be displayed on the LSDU are listed in Appendix II, to this document
- 3. Cabling Layout: All external cables shall be protected against the effects of lightning and shall comply with all requirements for the control of interference from EMI. All data cables shall be screened and shall be properly layered, separated and shielded from all power cables. All data cables should be CAT 6 compatible

4. Ventilation and internal temperature: All equipment enclosed by the cabinet shall be kept at a temperature consistent with manufacturers recommendations in prevailing ambient conditions
5. Finishing: The cabinet surfaces shall be protected from the environment in which it shall be used and the bidder shall specify the surface treatments to be applied. Each cabinet shall be painted and numbered in a manner consistent with the toll lanes (and by direction for reversible lanes) and consistent with all equipment related functions (e.g. reporting to the LSDU, IC etc.)

4.3.4 Technical Requirements

1. TLC/ALC must be an Industrial grade PC's available off the shelf and is designed to run in tough environmental conditions
 - a. The system shall be modular with Input / Output Card. There shall spare Input / Output ports. The number of spare ports shall be equal to number of Input / Output ports used.
 - b. Dimensions : Not to exceed 800mm x1000mm x300
 - c. 2 x 100/1000 Mbps Ethernet Based Outputs
 - d. Processor : Latest Intel Processor with fastest speed available in the market at the time of delivery at site and as approved by NTBCL
 - e. Hard disk : minimum 250 GB
 - f. Serial Communication Ports
 - g. USB Ports: 4 Nos on the TLC, In addition there shall be 3 Nos of USD ports available at the TCT to connect the USB Drive).
 - h. DIN-rail mounted circuit breakers and terminal blocks
 - i. Memory:4 GB RAM: Expandable up to 8 GB

- j. Support laptop/PC Connection for data transfer from the controller in case of network failure
- k. Shall support TCP/IP protocol and web based controls
- l. PCI Slots: There shall be spare PCI slots that shall be equal to number of PCI slots used.
- m. Operating temperature : -10degrees C to + 65C
- n. Housing :IP 54
- o. Lightning arrestor

4.4 Toll Collection Terminal (TCT)

4.4.1 Description of Functions

The toll collector's terminal (TCT) shall be positioned ergonomically in the tollbooth desktop workspace, and is the interface between the TLC and the toll collector. The purpose of this terminal is to allow the toll collector to view and enter information such as the classification of the vehicle, the method of payment used, validate transactions and perform other operations as discussed herein.

The TCT shall have the following facilities:

- a) Video Display (VDU)
- b) Keyboard
- c) A user authentication device (Biometric Scanner)
- d) Desktop mounted - smart card reader in the lanes (one on either side of the plaza) which supports ETC account re-charges
- e) Barcode scanner.
- f) Credit card terminal
- g) The features include
 - A video display unit (VDU) positioned so that it is easily read by the operator during daylight and at night time
 - Keyboard or similar interface that allows quick input via easily identifiable keys, for the classification, validation, MOP selection etc.

- An alphanumeric keypad and enter key for entering numeric data and violation info
- A key to request that a receipt or transaction record is printed on the lane receipt printer
- PCI Data Standards Compliant-Credit Card terminal
- A hand-held, trigger operated, short-range E-ID peripheral (a Barcode Scanner) that can be used to manually capture the E-ID

- In the event of the Barcode Scanner failing to read a tag / card, a key to indicate to the TLC that the details for the card transaction will be entered via the numeric keypad
- A means to extract shift reports from the TLC via the USB drive, after log-in by an authorised user of this function

4.4.2 Technical Requirements

4.4.2.1 Keyboard details

1. All keys (push buttons) used on the TCT should be a positive displacement (click) type, of rugged construction and capable of lasting 2 million cycles before failure. The function assigned to the key shall be engraved on the upper surface of the key and the engraving filled with a contrasting colour to the key background colour. A minimum letter height of 3mm shall be used.
2. The bidder shall submit full details of the layout and materials to be used in the keyboard construction. Membrane type keyboards shall not be used.
3. The keyboard or the system should preferably have an swipe card / biometric validation option.
4. The keys are divided into the following categories:

a) Classification keys

A key is to be provided for each class of vehicle. Two additional (spare) classification keys shall be provided.

b) Validation Keys

Keys shall be provided to validate the following transactions:

- Cash
- Exempt passage
- ETC - manual ETC capture or E-ID entry
- Credit ETC account

Violations are validated when the violation buzzer-silencing key is pressed.

An “ETC manual” key is provided to allow the numerical capture of an electronic identifier serial number, or to notify the system that the serial number will be captured by other means e.g. handheld barcode reader

A “Credit ETC Account” key shall be provided to accept payments to ETC accounts

c) Control Keys

These keys control certain equipment and software functions in the lane or

- Stop alarm buzzer key: To silence the violation alarm
- Receipt printer key: To issue a receipt
- Red cross and green arrow key: To change the OHLS status
- End of shift key: To indicate the end of the shift
- Cancel key: To cancel an incorrectly entered vehicle class and transaction
- Maintenance key: In maintenance mode, this key provides vehicles passage simulations.

d) Alphanumeric Keys

The numeric keys are used to enter the toll collector ID or credit or E-ID numbers in the case of a failure of the swipe card reader or ETC malfunction.

In maintenance mode, these keys provide access to the various maintenance menus and for equipment configuration functions.

Additional keys are provided to move around the menu items. These are:

- enter key
- tab key
- up, down, left, right arrow
- escape
- back-space

Key categories as described above shall be colour coded and grouped into functional blocks. The classification and validation keys shall be larger than the others for facilitated use. The keyboard shall be waterproof.

4.4.2.2 Video Display Unit (VDU)

The collector's VDU shall be 18 LCD/LED colour video display unit capable of high resolution (1366x768 dpi or higher)

4.4.2.3 Barcode reader / Scanner

A barcode reader / scanner will be installed in Mixed and Silver lanes to scan and read the barcodes printed on the receipt or E-ID printed on a Smart Card or an RFID Tag. It shall be connected to the TCT with a cable (or cordless) long enough that allows it to be used to scan the barcode printed on the RFID Tag affixed to a vehicle's windshield. It shall have the following minimum

specifications. A barcode scanner shall also be installed at POS Terminals.

Sr. No.	Parameters	Specifications
1	Scanner Type	Bi-directional
2	Light Source	650 nm visible laser diode
3	Scan Element Frequency	50Hz
4	Scan Rate	100 scans per second typical
5	Nominal Working Distance	See chart below.
6	Print Contrast	20% minimum reflective difference
7	Roll (Tilt) (1)	1 +/- 30 degrees
8	Pitch (2)	2 +/- 65 degrees
9	Skew (Yaw)(3)	3 +/- 60 degrees
10	Decode Capability	UPC/EAN, UPC/EAN with Supplementals, UPC/EAN 128, Code 39, Code 39 Full ASCII, Code 39 TriOptic, Code 128, Code 128 Full ASCII, Codabar, Interleaved 2 of 5, Discrete 2 of 5, Code 93, MSI, Code 11, IATA, GS1 DataBar (formerly RSS) variants, Chinese 2 of 5
11	Interfaces USB	USB, RS232, Keyboard Wedge, Wand,
12	Supported	IBM 468x/9x, Synapse and Undecoded
13	Operating Temp.	32° to 122° F/0° to 50° C
14	Storage Temp.	-40° to 158° F/-40° to 70° C
15	Humidity	5% to 95% relative humidity noncondensing
16	Drop Specifications	Unit functions normally after repeated 5 ft./1.5 m drops to concrete
17	Ambient Lighting Tolerance	Tolerant to typical artificial indoor and natural outdoor (direct sunlight) lighting conditions. Fluorescent, Incandescent, Mercury Vapor, Sodium Vapor, LED4: 450 Ft Candles (4,844 Lux) Sunlight: 8000 Ft Candles (86,111 Lux)
18	Electrostatic Discharge	Conforms to 15 kV air discharge and 8 kV of contact discharge
19	Electrical Safety	Certified to UL1950, CSA C22.2 No. 950, EN60950/IEC950

20	EMI/RFI	FCC Part 15 Class B, ICES-003 Class B, European Union EMC Directive, Australian SMA, Taiwan EMC, Japan VCCI/MITI/Dentori.
21	Laser Safety	CDRH Class II, IEC Class 2
22	Environmental:	Compliant with RoHS directive 2002/95/EEC

4.4.2.4 Biometric reader

Biometric reader shall be used for a user (e.g. Toll Collector) validation at every lane and workstations during login and cash exchange. The unit may be separate or integrated with the keyboard. The system shall maintain list of all system users with their fingerprints. The bidder may suggest an alternative to biometric readers. Biometric validation shall be part of TMS and related soft wares.

4.4.3 Alternative TCT Design

The bidders may propose alternative TCT designs that incorporate technology not mentioned in the above (Intelligent screens, customised keyboards, and other input devices). The interface must however always be intuitive and provide full functionality.

4.5 Receipt Printer (RP)

4.5.1 Description and functions

The lane receipt printer shall be located in the tollbooth and mounted in a position that will allow the operator to easily reach any documents printed on the printer.

The printer shall be of a compact size and use readily available paper rolls of a standard size with marker stripe to indicate the end of the roll (e.g. 75mm wide x 80mmf on 13mmf core). Thermal Receipt printers need to be used; The printer should use a thermal printer head.

4.5.2 Technical Requirements

The print rate should be sufficiently fast to print the details of a receipt or of a transaction in less than 2 seconds. The receipt or transaction record shall consist of at least the following lines of print:

- a) a header consisting of 2 lines of expanded font double height letters with a total of 30 characters
- b) a further eight lines of single space characters with an average of 20 characters per line
- c) the total length of the printed record is estimated at about 55mm

The receipt printer shall have an integrated paper-cutter.

A “paper out” message is to be sent to the TLC when there is no paper in the printer. This is to be displayed to the Toll Collector in the applicable booth.

4.6 User Fare display (UFD)

4.6.1 Description and functions

1. The User fare display (UFD) shall be located in the toll lane in a position where it is readily visible to and readable by Users from the pay point (i.e. 4 meters) under all weather conditions. The display has the primary purpose of informing the Users of the vehicle classification entered by the toll collector and the toll to be paid. It shall also convey ETC balance warnings, public relations and seasonal messages.
2. The UFD shall be of a variable message type and shall have a high intensity LED or similar NTBCL approved display of 16 characters per line in two lines with character height of 50 mm. UFD display feature should support normal and Bold mode character.

4.6.2 Technical Requirements

- ✓ Power Supply : 220V / 50 Hz AC
- ✓ Communication : RS232, 420mA Loop
- ✓ Enclosure : Corrosion resistant
- ✓ Operating Temperature : 10 C to + 65 degrees C
- ✓ Protection : IP65
- ✓ LED Reliability : 100 000 hrs

4.7 Traffic Light (TL)

4.7.1 Description and Functions

1. The traffic light shall be located in the toll lanes in a position where it readily visible to users of the toll road, usually on the side of the lane immediately beyond the tollbooth. The traffic light shall consist of two traffic light heads mounted on a suitable pole. A red signal is used to indicate that the road user should stop, whilst the green signal is used to indicate that the road user should proceed.
2. The traffic light may be incorporated into the user fare display, in which case it should comprise two high intensity LED Matrix displays with a minimum diameter of 70mm each. In this case, it must be noted that the system shall continue to operate in manual mode, i.e. the switching of the aspects must not depend on the status of the TLC. In the Gold Lane context the bidder shall consider appropriate direction indicator arrow instead of circle.

4.7.2 Technical Requirements

- ✓ The Traffic light system shall work in synchronization with the boom barrier
- ✓ The system shall have in-built night dimming function
- ✓ Size of display Approx 200 mm dia with sun visor
- ✓ LED Industry standard, Red and Green

- ✓ Housing Material : Corrosion resistant
- ✓ Environmental protection : IP 65
- ✓ Intensity : 9000 mcd for Red 4000 mcd for Green
- ✓ Operating temperature : -10 C to + 65 degrees C
- ✓ Power Supply : 230 \pm 10% VAC

4.8 Overhead Lane Sign (OHLS)

4.8.1 Description and Functions

The overhead lane sign (OHLS) is located on the leading edge of the canopy covering the toll lanes above the centre of the lane. The purpose of the OHLS is to indicate to the User whether the toll lane is open or closed for the processing of vehicles. A red cross is used to signal that the lane is closed, whilst a green arrow is used to indicate that the lane is open to traffic.

4.8.2 Technical Requirements

1. Signs must be sufficiently bright and directed to indicate to a motorist approaching the toll plaza, at a distance of 500m on a bright cloud free day that lanes are available for use
2. The cross and arrow aspects shall be at least 450 mm. The OHLS status shall also be visible up to a peripheral view of 45° from the travel axis
3. The LEDs shall have luminous intensity of at least 8000 mcd. Signs normally used include, fibre optic signs, high intensity LED and simple red and green traffic light heads
4. The sign shall be fitted with a sun hood to screen the effect of the sunlight
5. The enclosure of the OHLS shall be constructed from a corrosion resistant material. The enclosure shall have an IP65 rating and be ventilated to dissipate internal heat

6. The system shall have night dimming function

4.9 Manual booth controller (MBC)

1. Descriptions and Functions The manual booth controller shall be located in the tollbooth near the TCT. The purpose of the MBC is to allow certain of the lane equipment to be operated manually in the event that the TLC or TCT "hangs" or becomes inoperative. The MBC shall be powered from AVC UPS and it shall not be dependent on TLC for power as its main function is to work during TLC failure.
2. The following equipment is to be controlled by the MBC:
 - the overhead lane sign
 - the traffic light
 - Automatic lane exit barrier

4.10 Voice Communications

4.10.1 Description and Functions

1. Voice communication installed in the tollbooths shall provide "hands free" two-way verbal communication between the supervision staff in the toll control room and the toll collectors. The equipment shall also have the facility to allow the supervision staff to monitor communication between any tollbooths.
2. The voice communication system shall operate independently of the TLC. Voice communication shall also be implemented at various plaza building access points. The system should be unified to a single point in the toll control room.

4.10.2 General Requirements

1. The voice communication system shall operate independently of the Lane Computer system
2. Voice communication shall also be implemented in various rooms of the plaza building and at building access points
3. Two-way communications shall be possible as soon as the Supervisor responds by selecting the appropriate lane button on the Master Communication unit
4. One-way communication shall be possible from the Control Room intercom to all lanes simultaneously (broadcast)
5. In voice communication, end node of lane should consist only single button which directly hits only the control room console

4.11 Panic Alarm system

4.11.1 Description and Functions

1. When the TLC is inoperative, or communication between the TLC and the AVC is severed, the AVC, a panic alarm system from the tollbooth to the toll control room shall be provided. The alarm shall be silent in the tollbooth, but sound an alarm in the control room. The alarm is to be activated via a floor mounted foot activated switch, or a knee activated switch mounted on the inside wall of the tollbooth.
2. Activation of the panic alarm shall be monitored in the toll control room on the LSDU, and via a separate enunciation panel. The enunciation panel shall be designed so as to represent the toll plaza layout with a visible depiction of the activated alarm per booth.
3. The buzzer shall cease to sound once the alarm has been confirmed on the panel or LSDU.

4.12 Fog Light

The fog light is mounted on both the leading and trailing edge bull-noses of all toll islands of the toll plazas

4.12.1 General Requirements

1. The fog light shall conform to IP 66 rating
2. The fog light shall be able flash at a rate of 15-30 times per minute. The flash rate shall be adjustable using a potentiometer or other suitable means of adjustment.
3. The overall diameter of the LED matrix shall have a diameter of no less than 220mm and no greater than 230mm.
4. The LED Matrix shall be housed in an corrosion resistant enclosure that allows for horizontal and vertical alignment of the fog light.
5. The fog light shall be clearly visible up to a distance of at least 300m. The viewing angle shall be at least 20 Degrees from the central axis in either direction.
6. The LEDs shall have luminous intensity of at least 5000 mcd

4.13 Automatic Lane Exit Barrier

4.13.1 Description and Functions

The barriers are used to control the traffic through the lane. The operation of Boom Barrier is linked to the lane computer. It allows the vehicle to pass through after a successful financial transaction

4.13.2 General Requirements

1. The lane exit barrier shall be suitable for manual as well as high-speed ETC transactions.

2. One full closed-open-close cycle shall not take more than 1.8 seconds in the Mixed and Silver lanes. Where the barriers are being used in the 4W Gold (express) lane the barriers shall be capable of full lane closure from an open state in less than 0.6 seconds.
4. The housing and any mounting frame shall be fabricated from corrosion-resistant materials. The barrier may be driven pneumatically or electrically. The motor shall not be damaged when the barrier is blocked in any position.
5. Exit barriers shall have presence detectors independent to the AVC system to prevent barrier arms coming down on vehicles while passing. This shall be in the form of infrared units or dedicated embedded loops. Apart from the barrier arm, the mechanism may not have any moving protrusions that pose a risk to persons standing in close proximity to the barrier.
6. The barrier arm shall be fabricated from a light, corrosion resistant material readily and inexpensively available in India. The barrier arm shall further have a protective mechanism whereby swing open of the barrier arm occurs without damage to the housing or motor in the event of frontal collision..
7. The barrier shall have presence detectors independent to the AVC system to prevent barrier arms coming down on vehicles while passing. This shall be in the form of infrared units or dedicated embedded loops
8. Barrier arms shall have retro-reflective red stripes in accordance with the local traffic sign standards.
9. In order to prevent traffic from passing through the extra wide toll lane, manually operated lane-width limitation barriers will be provided by NTBCL, These will be placed at the entrances of the extra-wide lane. The barrier arms must rotate horizontally through 90 degrees and lock into position.

4.13.3 Technical Requirements

1. Ensure opening and closing timings remains constant under variation of wind speed
2. Acceleration, deceleration and smooth landing of boom without swaying at the end position
3. Optimum acceleration and deceleration based on the data from motor sensors
4. The barrier shall be such that it can be stalled and reversed at any position and programmed to avoid bouncing and swinging out at end positions
5. Low motor heat, Low electric and mechanic noise design
6. Efficient low voltage inverter motor within built Gear Reduction
7. Instant Reversibility
8. Sinusoidal Lever Drive System
9. Duty cycle : 100%
10. The Barrier shall be connectable with Loop detectors
11. Response time
 - a. Boom length upto 3000 mm: 0.9 Seconds for Silver and Mixed lanes and 0.6 sec for Gold Lane
 - b. Boom length 4500 mm : 2 sec
12. Mechanism to allow continuous operation by back up battery in case of power failure
13. Warranty : 5 million cycles or 2 years from the date of installation or 3 years from the date of dispatch whichever is earlier (1 cycle = 1 open and close)
14. MTBF : 5 million cycles (1 cycle = 1 open and close)

4.14 Electronic Toll Collection (ETC) (using RFID technology)

1. The Electronic Toll Collection (ETC) system automatically carries out the user fee collection without stopping the vehicle at the toll plaza. ETC at the DND and MVL shall be implemented to meet the requirements captured in this RFP under the sub-section Payment Methodology.
2. Electronic Toll Collection is a developed industry and the Equipment Supplier shall provide full details on the standards to which the system offered complies.
3. It must be noted that the installation requires the operation of ETC lanes in close proximity to other ETC lanes. It must also be noted that the Equipment Supplier shall be required to obtain the necessary approvals from the relevant authorities for the transmitting devices.
4. The ETC system shall be compatible with the ETC Smart cards and OBUs currently in use at DND and MVL.

4.14.1 Descriptions and functions:

1. Vehicle separators:

Equipment used to separate vehicles in all lanes shall sense vehicle continuity up to a height of 1.5 meters above the road level. The units shall be weatherproof to withstand all normal weather conditions. Separation units shall accurately separate vehicles at speeds up to 120km/h.

2. Descriptions and functions: Electronic Identifiers (E-ID):

Electronic identifiers (E-ID) shall be the mechanism whereby the ETC system is able to differentiate between User ETC accounts.

Media carrying the E-ID shall be suitable for mounting on the interior or exterior of a vehicle without requiring special fitment. Where exterior fitment is required, the media carrying the E-ID shall be corrosive resistant,

waterproof and adequately protected against Sun radiation. The size of the media unit shall not interfere with User visibility and should not be unsightly. The media shall be fabricated by method or utilizing material whereby counterfeit is not possible. If mounted on the exterior or interior of a vehicle, the media shall self-destruct upon attempted removal. Each such media shall have a unique identity, compatible with ISO referencing standards, which can be read by the ETC equipment for further processing by the TLC and TMS.

Each media carrying the E-ID shall also have an easily visible identity number that can be manually captured into the TLC, POS terminal or TMS. The identity number shall be consistent with the E-ID primary identification. By means of example, a media that passively transmits an identity should have a barcode label adhered to the reverse side of the E-ID for manual capture by a toll collector.

3. Automatic E-ID reader:

The E-ID reader is the equipment or system whereby the unique identification is obtained from the E-ID media mounted on a vehicle, whilst the vehicle is in motion past the E-ID reader in the applicable lane. The E-ID reader for RFID tags shall be capable of reading the E-ID media at speeds up to 120km/h in all weather conditions and during any time of the day. Such an E-ID reader shall be capable of processing up to 2000 vehicles per hour.

Such an E-ID reader shall not read past the “footprint” defined for any single lane, i.e. it will read an E-ID media only in the lane in which the reader has been installed. The “footprint” is defined as the boundary limits within which the E-ID will be read.

The reader shall be weatherproof to withstand all possible weather conditions in and around Noida. The necessary precautions should be implemented to protect the reader and if necessary the “footprint” against weather related identification inaccuracies or reading failures.

The equipment supplier must ensure that all national and international radio frequency allocations are adhered to if the nature of the equipment is such that radio frequency is utilized.

- The RFID-based ETC System shall be designed as per Specifications Document For RFID Transceiver and Tag For Nationwide ETC System by National Highway Authority of India, June 2011 for Interoperability, Lane level and Plaza level database requirement

4.14.2 Technical Requirements:

Specifications for RFID Transceiver

Sr.	Parameter	Particular
1	Frequency	UHF 865 MHZ to 867 MHZ *
2	Communication	Ethernet/ Serial communication (EIA standard RS 232 C)
3	RF Power maximum	1 W – transmitted & 4 W – EIRP (Equivalent Isotropically Radiated Power) *
4	Reading distance	With the Transceiver mounted typically at a height of 6 m above the road surface, the coverage of the antenna shall not
5	Antenna	Circularly Polarized
6	Protocol	EPC Gen 2, ISO 18000-6C and shall comply with the general conformance requirements of the
7	Visual diagnostics	The Transceiver shall have LED indicators for sense, transmit Fault and Power which shall be visible clearly to the operator on ground while the system is operational.

* is in the wireless license free band for RFID use in India. Typical existing product(s) for operates in the 865 MHz – 868 MHz band.

Environmental		
Sr.	Parameter	Particular
1	Enclosure	Light weight enclosure for the RFID Transceiver and circularly polarized antenna
2	Environmental	IP 65 or better for outdoor units
3	Relative Humidity	95% Condensing
4	Operating	-20°C to 55°C
5	Storage	-40°C to 85°C

Operating Characteristics

Sr.	Parameter	Particulars
1	Air Interface & Adaptive Noise Features	The Transceiver technology employed should have the capability to optimize read rates for the vehicle identification application and adapt to instantaneous noise and interference
2	Application capability	1. Should have read reliability exceeding 99.5% in the distance range specified. 2. Diagnostic and Reporting Tools
3.	Upgradeability	The firmware should be upgradable to support future protocols.
4	Transaction Capability	Reading of Tag & EPC memory for at least 2 Tags per second for a moving vehicle with a speed limit of 40 kilometers/ hour.
5.	Driver Software	The transceiver driver software shall be provided along with the transceiver that will interface to the ETC client through socket interface and handle the communication with ETC client. The packet structures shall be as notified in the ETC client-transceiver interface. The driver software shall implement filtering using a range of EPC-codes provided by set of bit pattern masks.

Specifications for RFID Tag

The Tags shall be essentially non-transferable RFID transponders designed to be used in conjunction with compatible Transceivers and are meant to identify the vehicle for ETC application.

General

Sr.	Parameter	Particulars
1	Power	Tags are Passive
2	Frequency	UHF 860 MHZ to 960 MHZ as per EPC Gen 2 standards
3.	Data Transfer Rate	At least 512 kbps under ideal conditions & 64 to 512 kbps under field conditions
4	Protocol	EPC Gen 2, ISO 18000-6C
5.	Dimensions (including the substrate/ backing)	Maximum area occupied on the windshield shall be 50 Sq. cm.
6	Material	Plastic substrate with printed antenna
7	Physical printing of Tag ID on the Tag	The Tag ID shall be physically printed on the Tag using the Hexadecimal numbering system and shall be adequately clear for easy visual recognition

Environmental

Sr.	Parameter	Particular
1	Relative Humidity	95% Condensing
2	Operating Temperature	-20°C to 80°C ambient
3	Storage Temperature	-40°C to 100°C

Installation

Sr.	Parameter	Particular
1	Location	The RFID Tag shall be installed at a fixed location on the inside of the Windshield of the vehicle. *
2	Installation mechanism	<p>The RFID Tag shall have a self-adhesive backing with which it can be fixed to inside of the windshield. The adhesive shall be such that</p> <ul style="list-style-type: none"> It allows reliable and accurate reading of the Tag by the Transceiver located at a specified distance. The RFID chip and/ or the antenna get irreparably damaged when an attempt is made to remove the installed Tag from the windshield by any means. After such an attempt the Tag shall become inoperable.

*location to be optimized for each class of vehicle during trials

Memory

Sr.	Parameters	Particulars
1	Tag Memory (minimum)	Unique Tag ID – 64 bits, EPC memory – 240 bits
2	Data Retention	10 Years minimum with UV protection for normal sunlight exposure and ambient temperature of 45 Deg C

AVI PROCESSES

To ensure standardization as well as security in the system, vehicle identification as well as Tag commissioning & initiation processes are also defined below.

Tag Commissioning

Each Tag will be required to have a non-changeable and unique Tag ID, which must be read by the Transceiver at the point-of-sale.

At the time of commissioning, the point-of-sale module shall read the unique Tag ID and allocate an EPC code & a randomly generated initiation code. It shall then write the EPC code, Vehicle registration number, vehicle class code and the initiation code in the EPC memory area using the software module provided. The Tag ID, EPC code, Vehicle registration number, the vehicle class code and initiation code shall also be stored in the central database.

Tag initiation

Tag initiation will be a process carried out during Tag commissioning or when the original owner suspects a cloning of the Tag.

In the first case, the Tag initiation software shall generate a random initiation code, write in the Tag and store in the central database.. Each time a Tag is read by the Transceiver for tag commissioning, a new initiation code will be generated, written on the Tag and stored in the central database along with other information.

In the second case, the Tag initiation software shall generate a random initiation code and read Tag ID, EPC code, vehicle registration number & vehicle class code from the Tag mounted on the windshield. After due verification from the central database, the value of initiation code shall be updated on the Tag as well as on the central database. Old initiation code and EPC code shall be marked for special handling for 'catching' the clone as and when the cloned Tag comes into contact with Transceivers at the toll gates.

Automatic Vehicle Identification at Toll Point

The communication sequence between the Transceiver and Tag shall conform to ISO 18000-6C. The Transceiver shall retrieve the Tag and EPC memory contents for those Tags whose EPC code satisfies the mask stored in the Transceiver for a matching entry. The EPC code shall be used to index into the database from where the Tag ID, Vehicle registration number, the Vehicle class code and the initiation code will be retrieved from the database and verified against the

corresponding values read from the Tag

4.14.3 Hand-held RFID Reader

1. To read EPC global Class 1 Gen 2 (ISO 18000-6C) tags (Tag Specifications provided in this tender document).
2. The read range shall be adequate to read tags affixed on relevant types/classes of vehicles with the user / operator standing on ground at a reasonable distance.
3. It shall have the facility to read the TID, EPC and User memory contents of the tag with / without appropriate Access Password protection
4. Shall be access controlled with both hardware & software keys. Shall have memory capacity to store data of minimum 1,000,000 transactions and 1,000,000 blacklisted tag details and battery capacity of 24 hrs continuous operation.
5. The reader shall have adequate interfaces for data transfer to / from a host computer for the purposes of uploading transactions and downloading blacklists.

4.15 Credit card Terminal & user validation

4.15.1 Description and functions

1. The credit card terminal shall be located in the toll booth & POS and mounted in a position that will allow the toll collector / POS operator to
 - Pass an ISO 3554 standard magnetic card easily and quickly through the reader.
 - Insert a Contact Chip Card for reading.
2. It shall be Payment Card Industry Data Security standards compliant

3. The terminal shall have the capability to accept a PIN entry from the road user.
4. The terminal shall be able to connect-up and obtain on-line authorisation from a bank switch / host.
5. The Terminal shall interface with the TLC for transferring the Credit Card Transaction details for inclusion in the Toll Transaction.
6. The terminal may be suitably mounted on the TCT.
7. Visual and audio indication shall be present to indicate whether the information on the card was read successfully.
8. Long life reader heads must be supplied in the terminal. Reader heads using ceramic or titanium replaceable units are acceptable.

4.16 Contactless Smart Card Reader

4.16.1 Description and functions

The Contact less Smart Card (CSC) reader shall be by default in the 'Ready' state, once the Toll Collector / Maintenance user / Supervisor (in case of Automatic ETC Mode) logs in. Whenever there is a smart card based transaction, once the user / toll collector attempts to read the card, a beep sound shall be raised indicating the successful reading of card. In case of failure to read the card (due to damage to card / invalid card), the same shall be displayed in the TCD to alert the Toll Collector; in addition to the log of this failure in the LSDU.

a) Desktop Reader:

These readers shall be installed at the POS and in designated lanes in each direction of each plaza to enable the ETC recharge in the Toll Booth.

b) External Reader:

This shall be mounted externally at the pay axis.. There shall be a display on the External card reader showing the current status of the reader. There shall be an audio-visual alarm signaling the success / failure of the reading of card by the user in the reader in addition to the alarm in the TCD. External Readers shall be provided in all Silver and Mixed lanes.

4.16.2 Technical Requirements

1. The reader shall have the ability to read the smart card from a distance, ranging from 0 cm to 10 cm
2. The reader shall conform to ISO Standards: 14443A
3. Transmit Frequency: 13.56 MHz
4. Read Success: Beep Alert
5. Display: LCD or LED Status Display
6. The operating temperature of the Smart Card Reader should be –10 degrees to +65 degrees C
7. The Operating humidity of the Smart Card Read/Write shall be upto 95% non condensing
8. It shall have the capability to read from / write into Microprocessor-based Contactless Smart Cards with facility to validate with security keys / mechanisms provided by the Security Key Management System of a Central Clearinghouse(s)
9. All transactions shall be secured with modern cryptographic techniques based on DES/3DES mechanisms to resist fraud and to deter theft or misuse
10. The bidder shall provide dedicated secure POS systems at identified customer care centers located in the toll plaza. The POS terminals shall be integrated with the ETC backend system (Part B). The system shall read / write the smart cards compatible to ISO 14443A standards

Power Source

The CSC Readers shall receive UPS power from the TLC. Any special electrical protection / interface unit shall be provided by the Supplier, if required, based on the needs of the device.

Protection

The External CSC Readers shall be IP 65 rated and the internal CSC Reader shall be IP 54 rated.

4.17 Automatic Vehicle Classification (AVC)

4.17.1 Description and Functions

1. The automatic vehicle classification equipment shall be located in the toll lane beyond the point of payment. The position and physical length of the vehicle detection portion of the equipment is critical, as it must be far enough from the point of payment and short enough that two vehicles processed on separate transactions cannot pass into the area of the vehicle detection system at the same time.
2. The purpose of the AVC is to sense the presence of a vehicle, to measure and interpret certain physical characteristics of the vehicle as it passes through the AVC so that an unambiguous vehicle class category can be identified.
3. The AVC shall be able to distinguish between classes as defined in Section 3.2 above. This class information shall be communicated to the TLC. The TLC shall check that this information matches the classification entered by the toll collector. If there is a discrepancy between the two classifications, CCTV cameras shall be caused to capture a digital image or video clip of the vehicle as well as the image of its number plate. The digital image, video clip and discrepancy information shall be communicated to the IC for further processing by the toll supervision staff.
4. The AVC shall determine the number of vehicle classes to an accuracy of at least 99.6% and vehicle count of 100% of that detected visually by two independent observers. The Equipment Supplier shall submit details of the performance of existing AVC systems duly validated by the existing operators of the systems.
5. The AVC shall be capable of detecting and reporting the following vehicle movements and incidents in the lane to the TLC:

- Wrong Direction - vehicles travelling in the wrong direction through the toll lane
 - Roll Back - vehicles travelling into the AVC area and then reversing back to the payment point
 - Vehicle Standing - the vehicle presence sensing equipment stays active for longer than a pre-set time (usually 3 minutes). The preset time shall be a parameter settable by the Operator.
6. All AVC elements shall be fully weatherproof and installed in a location where vehicle damage by accident is not possible. All the sensor adjustment shall however be made to be tamper proof.
 7. When the TLC is inoperative, or communication between the TLC and the AVC is severed, the AVC shall record the last transaction number transmitted and shall be able to independently count and record vehicle classes passing through or over it.
 8. The AVC is also to automatically indicate to the IC that it is unable to communicate with the TLC. It shall also notify the IC when communication with the TLC is re-established. A sequential vehicle counter at AVC level shall be implemented to reconcile the AVC and TLC transactions based on the transaction number.
 9. The AVC shall have its own battery backup and data extraction facility (e.g. via USB).
 10. The accuracy of the AVC shall not be affected by temperature or weather conditions.
 11. The bidder is free to propose AVC with any type of technology, however its Classification Accuracy shall be 99.6% and count accuracy 100%. The bidder shall provide in-depth details of AVC technology proposed in their technical proposal.

4.17.2 Technical Requirements

1. The system shall be able to detect the vehicle moving in wrong direction
2. The system shall be able to count the axles with high precision and accuracy
3. AVC Processing Unit
 - a) Shall be real time processing unit
 - b) Shall be the trigger source for Lane Camera System
4. AVC should ensure an accuracy of 99.6% in vehicle classifications and 100 % accuracy in vehicle count. The TLC / AVC application shall be consistent and standard across all the above types of lanes and should be configurable to specify the type of lane and the sensors that would be connected for each of them
5. The TLC/ALC OS should preferably be hardened OS that would only allow the most essential TLC / AVC application and related equipment to function and completely restrict access or running of any other services or processes
6. TLC/ALC shall have adequate physical security at an individual PC level to ensure protection against any malicious intent
7. The TLC/ALC OS and application shall support contemporary serial port hardware cards for easy connection of serial devices
8. The TLC / AVC application shall interface with various types and makes / models of sensors and in-lane equipment that would be available in the market
9. The TLC / AVC application shall have adequate flexibility and conform to standards to enable integration with new technologies
10. The TLC / AVC shall be completely capable of operating in a stand-alone mode to circumvent outage due to any network failure up to at least one month
11. The online transactions generate by TLC/AVC shall be stored in an encrypted / encoded format and should have adequate complexities and

protection to ensure that the integrity of the data cannot be compromised by a malicious attacker

12. In the event that the above information is being stored on the TLC / AVC in a database, the database has to be an extremely lightweight one, with very limited requirements and overheads on the system. The interoperability of such a database with a hardened OS must be established
13. In the event of a database being used at a TLC / AVC, the security of the database, the licensing cost of the same, encryption / encoding of the same and regular housekeeping of the same to be provided in detail separately
14. The local data storage format (file or database) at the TLC / AVC would have to be for a minimum of 3 months
15. The communication of the TLC / AVC with the central TMS system should be on a secure channel and should have adequate encoding / encryption to guard against online tampering of the data
16. Two separate streams of data, carrying vehicle classification information from TLC and AVC shall be copied at TMS level for comparison, evaluation and audit purposes. There shall be provisions for drawing separate reports for TLC and AVC classifications at TMS level. An AVC accuracy and reconciliation report shall be present in the toll system.\
17. The performance of the AVC shall form the basis for the accuracy checks, functional tests, installation, commissioning and handover to achieve the required accuracy and performance. All design and installation approvals shall be obtained from the NTBCL before installation and commissioning. The supplier shall submit a detailed list of vehicles with photographs and Indian RTO authorised classification category of all models of vehicles found in India as part of Technical specifications delivery. The configuration of AVC classification table into the system shall be done in the presence of the NTBCL / Authorised representative of NTBCL.
18. The plaza lane area detailed AVC layout including the following items shall be provided at the time of technical specifications delivery by the Bidder so

that the design process can be implemented at site. The Bidder shall ensure that the equipment layout is in conformance with the Lane Design Drawings as provided by the NTBCL.

19. The system architecture shall provide the details of the equipment layouts and the physical location of each component of the system in the toll lane.
20. Sensor replacement time shall not exceed 30 minutes.
21. It shall be noted that the equipment enclosures shall be mounted in the tunnel running under the plaza, sufficient ventilation shall be provided by the equipment bidder for this enclosure and the enclosure shall have IP54 protection. Under no circumstances the equipment enclosure/cabinet will be allowed to be mounted in the toll booth.
22. The AVC enclosure shall be mounted in the tunnel. The AVC enclosure shall be secured using suitable corrosion resistant fixtures, and all fixtures shall be approved before the mounting of the AVC can take place.
23. The AVC enclosure shall be provided with a switch to detect that the AVC door is open or closed, and the status shall be updated at LSDU level in real time.
24. All mounting shall be done in a neat and professional manner and shall be approved by the Concessionaire.
25. All AVC cables that enter the enclosure shall be protected between the enclosure and the sensors, using a suitable flexible steel re-enforced trunking / cable tray / ducting as approved by the Concessionaire to reduce the risk of tampering. All the cable entries to the AVC enclosure shall be sealed properly with glands / sealant, as approved.

AVC Computer Configuration

a)	Grade :	Industrial PC
b)	HDD :	Based on estimated storage requirement for 6 months AVC data (at least 160 GB in case estimated capacity is lesser)
c)	RAM :	2 GB or latest as approved by Concessionaire
d)	Processor :	Latest Intel Processor as approved by Concessionaire
e)	Processor speed :	Latest available in the market at the time of delivery to the site as approved by Concessionaire
g)	NIC :	1 Gbps X 2 Numbers On-board
h)	PCI Slot :	2 Nos. Spare
i)	USB Port :	4 nos.

4.18 Lane Status Display Unit (LSDU)

4.18.1 Description and Functions

1. The LSDU shall provide a graphic display of the toll lane status and allow individual and global control of toll lane peripherals and toll collector functions as follows:
2. The following TCE status indications shall be shown graphically on the LSDU for each lane:
3. The Display size shall be large enough to display the entire plaza graphics at once glance.
 - Schematic of all lanes
 - Overhead Lane Sign: Indicating lane open / closed
 - Direction open
 - Lane mode selection and status: Idle; Open; Fault or Maintenance
 - Indication of whether lane is operating as Gold , Silver or Mixed lane
 - Approximate traffic processed per hour shown for each lane, updated continuously
 - Traffic count averages over user defined time spans per direction
 - Panic Alarm Status (also audio indication).
 - Exit barrier mode: Barriers in automatic or open mode
 - TLC network status: Local mode or connected to the CCS
 - TLC Power supply: UPS or mains power (only if individual UPS units are installed with every TLC)
 - Downloaded table status for most recently implemented tariff table
 - Cabinet door monitoring TLC / AUC

4. The following toll collector control functions shall be available via the LSDU:
 - Toll collector login and logout requests
 - Permission to open and close lane
 - Open / Close ETC express lanes
 - Reset ETC express lanes
5. The LSDU computer shall further monitor and display in text format (on a split or separate screen), all TLC incidents such as listed in Appendix II. The incidents shall be categorised under the following headings for reporting purposes:
 - Financial-related incidents
 - System incidents
 - Operational incidents
 - Hardware incidents
6. The system shall allow user-definition of incidents into levels of importance for display on the LSDU and shall further allow user-definition of whether each incident should be acknowledged. Once an incident has been assigned a level of importance, the incident shall be highlighted onscreen by means of colour coding or similar manner of prominent display e.g. an incident of highest importance may be coded red and requires to be acknowledged by the supervisor, whereas an incident of little importance shall be coded green and require no acknowledgment.
7. The information shall be time-stamped and related to specific lanes. A shift shall not be closed until the supervision staffs have acknowledged all incidents that have been defined to require such attention.

8. The following additional functions are required:
- Equipment fault identification with option to forward to maintenance department via e -mail or internal messaging system
 - Overview of access control – access controlled doors left open; safe door open; TLC enclosure door status
 - The option of taking over the control of any lane for monitoring and operating purposes
9. The LSDU shall have the facility to change the message on the UFD:
- per direction
 - per lane
 - globally
10. The LSDU shall also have 5 settable preset messages that can be instantaneously selected for display.

Notes:

Messages shown on ETC UFD's may be overwritten with ETC account details when the balance has been reached a threshold

The LSDU computer shall control user access (limited to supervisors and plaza management) by means of passwords local to the system. Supervisor login / logout shall be time-stamped accordingly. The LSDU shall allow only a single user to be logged on at any time. Logout of the supervisor on shift shall be automated by the login of the substituting supervisor.

The time and date shall always be visible on the LSDU interface.

The list below provides an example of the message types and detail to be displayed on the LSDU. A comprehensive list of all possible occurrences affecting the integrity of the toll system, system security, staff security,

equipment function, software status, systems communication etc. shall be produced by the equipment supplier. In addition to this, NTBCL shall be able to design/make any activity to be an incident in the TMS and get its status/reports on LSDU.

1. Date / hour change
2. Manual lane open
3. ETC lane open
4. Mixed lane open
5. Lane closed
6. Request to open lane
7. Request to close lane
8. Request to pause lane
9. Confirmation to open lane
10. Confirmation to close lane
11. Confirmation to pause lane
12. Time expiration for lane open after confirmation
13. Time expiration for lane close after confirmation
14. Time expiration for lane pause after confirmation
15. Invalid toll collector
16. Tariff change
17. Lane into maintenance mode
18. Lane out of maintenance mode
19. Vehicle detected without collector classification
20. Vehicle discrepancy
21. Time exceeded for vehicle exit from lane
22. Classification cancelled [for toll collector, lane]
23. Vehicle reclassified
24. Extra receipt printed
25. TLC enclosure opened [sound buzzer]
26. TLC enclosure closed
27. Low disk space warning on TLC
28. Low disk space warning on CCS
29. Low disk space warning on local drive
30. Insufficient memory warning on CCS

31. Loss of communication of IC with CCS
32. Communication with CCS re-established
33. Loss of communication with TMS server
34. Communication with TMS server re-established
35. Change of TLC mode without permission
36. Equipment failure: Sensor 1
37. Equipment failure: Sensor 2
38. Equipment failure: exit barrier
39. Equipment failure: AVC
40. Equipment failure: etc. for all equipment
41. Database corrupt [all database]
42. Toll collector confirmed bleed-off
43. Vehicle without valid E-ID detected in the express lane
44. Panic alarm initiated
45. Shift opened
46. Shift closed
47. Change in toll collector database
48. Change in user access level
49. ETC: E-ID unreadable
50. ETC: E-ID account insufficient funds
51. ETC: E-ID blacklisted
52. ETC: E-ID
53. Failure reading tariff table
54. Extra large vehicle detected
55. Toll collector login
56. Toll collector logout
57. "Cardkey" key used to manually enter credit card number
58. MOP – Credit granted
59. MOP – Credit / Fleet card
60. Run through violation
61. Class discrepancy – Over-classification
62. Class discrepancy – Under-classification
63. Mini shift requests
64. Bad card - Swipe card reader

- 65. Illegal card – swipe card reader
- 66. Blacklisted card
- 67. Credit card expired
- 68. Extra wide passage detected
- 69. Vehicle class cancelled

4.19 CCTV Cameras

4.19.1 Description and Functions

Separate CCTV systems will be used for:

- CCTV surveillance
- Toll operations incident frame grabbing
- Vehicle / registration plate surveillance

1. **CCTV Video cameras:** The cameras shall be charge coupled device (CCD) colour cameras equipped with fixed focal manual iris lenses. The cameras shall require a minimum of 1.8 lux for usable video. The CCTV systems shall have adequate surge and lightning protection.
2. **Incident frame grabbing cameras:** Each camera shall view and detect vehicle images on video for every lane. The cameras shall be located so that a sidelong profile of the vehicle is obtained as it crosses the AVC. Each lane shall have a dedicated frame grabbing camera.

The camera installed at a convenient location shall be used to capture images of the following incidents:

- a) Class discrepancy between the class detected by the AVC and that entered by the toll collector
 - b) Exempt users
 - c) All transaction of vehicle and special events
 - d) Offending vehicles
- When the alarm footswitch is activated by the toll collector
 - Vehicles with ETC / Smart Card payments

3. **Camera for Licence Plate Number Reader (LPR):** The System should scan and store images of the License Plate Numbers of the vehicles passing through the toll lane.
- a) The LPR Camera system shall be designed to capture with a high level of clarity the number plate of a vehicle paying toll. It should have both auto trigger and manual trigger facility, which should be configurable parameter,
 - b) LPR Camera system should capture Front side number plate of the vehicle and NOT THE REAR NUMBER PLATE.
 - c) The Camera and Infra-Red illumination units shall be housed in a single enclosure
 - d) LPR Camera should be able to function in all types of light condition and should be able to read number plates of India (i.e. non-standardized and reflective as well as non-reflective)
 - e) LPR Camera should be integrated with the toll application software.
 - f) The above integration shall be done in a manner that it shall be possible in future, to add a standard Optical Character Recognition (OCR) module to the system such that the system can read, recognize and identify (i.e. to give back the license plate as a text and all of the characters found on the image) the vehicle as and when the image of the License Plate is acquired.
 - g) The system shall capture two row plates

- h) The system shall capture
 - white characters on black background
 - black characters on white background
 - black characters on yellow background
 - High Security number plates
 - i) It shall display on the TCT a clear image of the License plate during the time period when the toll transaction is being performed/ captured.
 - j) Each license plate image shall be linked with the respective transaction.
4. **Camera Location:** The Equipment Supplier shall determine the best mounting positions for the cameras so that so that effects such as direct sunlight and stray lighting is negated. The cameras shall also be protected from or be resistant to high winds and moisture. Vibration shall be minimised such that the image quality is never compromised.

4.19.2 Technical Requirements - Cameras

1. CCTV Video Cameras:

- a) The housing will be equipped with a hood to protect the camera under direct sunlight
- b) Protection : IP 65
- c) The stand of the lane camera shall be made in steel tube that will not swing or twist under gutter speed of strong wind. The stand will be protected from corrosive environment conditions
- d) Image Sensor : 1/3" CCD
- e) Horizontal Resolution : 525 lines
- f) Sensitivity : 0.004 lux

- g) Shutter speed : 1/100 – 1/100,000 sec
- h) AGC (in full) : Automatic with manual override
- i) White balance : Automatic with manual override
- j) Operating temperature : -10 C to +50 C
- k) Video output signal range : VBS 1.0 Vp-p
- l) Video output impedance : 75 Ohms
- m) S/N Ratio : > than 50 db
- n) Power Supply : PoE
- o) It should support ONVIF protocol
- p) Make : Samsung, or equivalent

2. LPR Cameras:

- a) IR 2000 W Lamp
- b) IR Filter
- c) Lens (auto iris between 1/50 to 1/1000000 seconds)
- d) It should be latest IP digital camera for LPR use
- e) Low power consumption
- f) Synchronizing unit
- g) File handling BMP and JPEG

3. Network Video Recorder

1. The NV recorder shall have the facility to record images on the hard disk and also on external recording devices such as DVD, etc. The network video recorder shall have data storage capacity for storing of 30 days and shall have interface to archive the data on to the DVD / Tape for back-up
2. The NVR shall be suitable for a minimum of 64 video signal inputs, capability alarm / event based recording and shall have the facility for high speed searching based on inputs such as date, time, etc.

3. The Network recorder shall have the functionality to display multiple video images simultaneously / selectively on a single monitor.
4. The CCTV Surveillance system shall have capabilities to have High Quality live video steaming at Mumbai Head Office without any jitter. Connectivity for the same shall be provided by NTBCL. Agency to suggest bandwidth required to view at least 8-10 cameras in real time.

4.20 Incident Computer(IC)

4.20.1 Description and Functions

1. The IC shall be located in the toll control room. Its principal function shall be to alert the toll supervision staff to, and allow resolution of any class discrepancies or violations that may occur in the toll lanes.
2. The IC shall have online information current to less than 2 seconds real-time at all times.
3. The display shall indicate at least the following information for each discrepancy or violation:
 - a) Lane number
 - b) Lane direction
 - c) Toll collector logged in
 - d) Vehicle class classified by the toll collector / E-ID registered class
 - e) vehicle class detected by the AVC
 - f) MOP
 - g) Digital image thumbprint or video and reference number, linked to a digital image
 - h) Transaction number
 - i) License plate image

4.20.2 General Requirements

1. The IC shall allow the supervisor that is logged into the system to correct the vehicle class incorrectly classified by the toll collector / wrong ETC class in Tag /OBU/ Smart Card, or incorrectly detected by the AVC system so that an accurate traffic database is maintained. Each incident resolution shall record the supervisor identification and time of intervention. In the case of an ETC Transaction where a wrong class has been detected, only the 'audited' class i.e. that finalised by the supervisor shall be sent to the ETC backend system for settlement.
2. All incidents have to be resolved for each toll collector before the end of shift. The toll collector shall not be allowed to cash up until all incidents have been resolved.
3. Each discrepancy that requires resolution by the supervising staff shall be summarised in the cash-up report drawn by the toll collectors at the end of shift. Class discrepancy errors allocated to toll collectors shall be flagged for their cost.

4.20.3 IC Printer

The IC printer shall also be the printer used for general reporting in the toll control room. It shall be a laser printer capable of printing 24 pages a minute.

4.20.4 Technical Requirements

1. Any violations / incident (difference in data captured by TLC and AVC for the same transaction) detected should immediately activate and store a video recording of the contentious event for a total time span of about 15 – 20 seconds, starting from the time the vehicle is lined up with the Toll Booth
2. Recordings of Violations / Incidents should be captured locally on the TLC and then immediately transferred, as close to real-time as possible to a

separate central server that would host these images for further viewing and validation by a Toll Supervisor

3. The video data of the violations/ incidents that is stored on the TLC should be regularly purged, once the same has been cleared by the Toll Supervisor. This process has to be completely automated and transparent to an end Toll Collector.
4. The video data that is stored on a separate central server needs to be retained for a period of at least 2 years, post which it can be archived and moved to a separate media / location.

4.21 Central Computer System (CCS)

The CCS is the central node of the toll system and is critical to the system operations. The Equipment Supplier shall give careful consideration to the design of the hardware and the related software to ensure a very high service level. The system shall include all the modern features of data replication with its clients for mission-critical data, RAID technology, fault tolerant subsystems, and proper isolation from the effects of power surges and lightning for electrical and data inputs. The CCS shall also have a local UPS. Full details of the system shall be submitted with the proposal.

4.21.1 Description of Functions

1. **Communication with the TLC's.** The central computer system (CCS) shall be located in computer room in the plaza building. Its principal function shall be to communicate control data to the lane TLC's and receive transaction and other data from the lane TLC's.
2. **Communication with the TMS server:** The CCS shall be capable of communicating data to and receiving data from a Toll Management System (TMS) computer server operating a database system under an open operating system such as Windows LINUX or above. The purpose of the

TMS is to supply financial and traffic reporting and data to management. The server shall also be located in the computer room at the Plaza Building.

3. **Communication with the LSDU:** The CCS shall communicate with the LSDU if required, to provide full functionality as described under Section 4.18.
4. **Communication with the IC:** The CCS shall communicate with the IC to provide online incident reporting, and to provide the facility to resolve incidents as described under section 4.20.
5. **Communication with ETC Client.** This communication mainly involves the routing of transactions to the ETC backend via the ETC Client and receiving the updated ETC whitelists, blacklists and ETC user account balances from the ETC backend again routed through the ETC Client.

4.21.2 ETC Backend System

The ETC Backend system shall include a server configuration (one or more servers – Database, Application, Web-Server, VAS server for Mobile and generation of SMS alerts etc)) that offer the following main functionality

- ETC host holding all ETC User accounts including the balances
- Transaction settlement of ETC transactions received from the ETC client of Part A i.e. debiting an user account by the appropriate toll amount on the receipt of an appropriate ETC transaction from the TMS.
- Point of Sale system including those features related to POS terminals
- Road-User web portal for on-line recharge and generating usage reports
- Stock Management of Smart cards, RFID tags and OBUs
- Generating whitelists, blacklists and sending them to the TMS via the ETC client along with the balance amounts in individual ETC user accounts.
- Allowing authorized system users to add any ETC account to the blacklist for reasons other than inadequate balance and remove the account from the same.
- Sending SMS / E-mail messages to ETC Users e.g. on ETC Transaction, Low balance threshold reached and Receipt of Payment.

- Credit ETC user accounts based on 'Credit ETC account' transactions received from the TMS corresponding to Lane recharges..
- Identifying tags, cards, OBUs linked with wrong vehicle classes (identified by the Incident Management process of the TMS system) and reporting them.

4.21.3 TMS Server

1. The Toll Management System (TMS) shall be responsible for processing the data into information that will be used to verify toll transactions, provide toll collector control and performance facilities, and shall include a host of management tools and reports for the effective administration of the toll operation. The TMS shall also assist in auditing the toll collection operation. It shall be a modular unit with the capability for various modules and functions to perform independently at the different levels of the toll collection operation
2. The Equipment Supplier shall give careful consideration to the design of the TMS server to ensure a very high service level. The system shall include all the modern features of data replication with its clients for mission-critical data, RAID technology, fault tolerant subsystems, and proper isolation from the effects of power surges and lightning for electrical and data inputs. The TMS shall also have a local UPS. Full details of the system shall be submitted with the proposal.
3. Technical Specification of TMS server

In the Technical Bid the bidder shall clearly specify the server's architecture with storage and clustering with mapped roles, in addition to the technical specification of the servers.

4.21.4 General Requirements

1. The roles of the **TMS system** could be distributed across multiple physical / virtual servers as would be required. The different roles include : -
 - Database Server
 - Application Server
 - ICS server
 - Transaction Processing Server
 - Data base Backup server
 - Anti-Virus Server
 - Domain Controller
 - Aggregation Server (Aggregating information across Plazas)
 - ETC client server to hold white lists (along with the remaining balance amount in each ETC user account) , black lists received from the ETC backend system (and other ETC programs) and to send ETC transactions received from the TMS to the ETC backend System (and clearinghouses of other ETC Programs) for settlement.
2. The set of servers listed above shall be common for both plazas i.e. the equipment located in both plazas shall be connected to a single set of servers located at the DND Toll Plaza.
3. The Servers' Operating System shall be standard available off- the- shelf in India and that is widely used and has adequate support.
4. The server configurations shall be latest available in the market.
5. Operating system and RDBMS should be capable of being migrated to a new higher version once the version currently proposed is withdrawn by the provider.

6. For the OS, the supplier shall ensure that security updates and latest service packs, "patches" are loaded.
7. The critical servers should be configured for a high availability solution to ensure maximum uptime and no loss of data or impact on operations
8. There should be a provision to replicate data to an alternate site in the event of a complete disaster to ensure that there is no complete loss of information
9. The TMS system should have a robust and scalable database platform and should be capable of segregating data by a time frame to enable easy retrieval and archival of historical data
10. The database shall be an industry standard database and shall be supplied with all the latest service packs and patches.
11. The ETC Backend system should be capable of importing the existing database (related to the ETC User and the Usage) and retaining it in a proper format and structure that would be capable of generating any desired report as and when required
12. The TMS system should be unique for each plaza (DND/MVL) and should have a top layer which would aggregate data from multiple plaza servers and collate for reporting purposes
13. ETC client

The ETC Client is an important part of the Toll Management System being the ETC gateway of the TMS to various ETC programs including the ETC Backend System. It shall have the following functionality:

- hold white lists (along with the balance amounts in individual ETC user account), black lists received from the ETC backend system (and other ETC programs)
- send ETC transactions received from the TMS to the ETC backend System (and clearinghouses of other ETC Programs) for settlement.

- Provide instantaneous response to a query from a Lane PC that has just read an EID, with reference to the EID existing in white lists (and the balance amounts), black lists currently held.
14. The database server should be well secured and should not be accessible to any user directly.
 15. Any access to the database server should be only through the Transaction processing module, the application server or the Value added services module
 16. There should be no direct access to the database from a TLC / AVC or a Back Office machine in order to ensure adequate security of data
 17. The TMS system should process transactions from the lanes at as close to real-time as possible
 18. The TMS system should send information such as login information and tariff tables to each of the TLC's in the prescribed format at regular intervals not exceeding 20 minutes (real time is desirable) between two successive updates
 19. The information generated for storage on the TLC local machine should be in a well encoded / encrypted format that cannot be easily modified / altered
 20. The various types of workstations and their required quantities are given below:
 - LSDU : 2 Nos
 - Cashup (Including Cashier) : 6 Nos
 - POS : 6 Nos
 - ICS (Audit / review) : 5 Nos
 - Admin : 5 Nos

4.21.5 Firewall

Fire wall will be provided by NTBCL.

4.21.6 Toll Administration and POS Computers

These computers shall be the latest generation windows compatible computers. Point of sales computers shall have reader cum writers and devices for personalisation of Smart Cards, RFID tags and OBUs as well as a laser printer each, capable of printing 24 pages per minute.

Minimum Technical Specification will have as following

Components	Details
CPU	Latest Intel Processor with latest available speed in the market at the time of delivery
Hard disk	250 GB
RAM	4 GB DDR
Operating System	Windows 7 or equivalent with latest service pack & patches

4.21.7 Cash-up Terminals

The cash-up computers shall be placed in the cash-up room at the plaza building. The cash-up process is defined in chapter 5.

Each cash-up computer shall have a single laser printer capable of minimum 24 pages per minute attached to it.

Minimum Technical Specification will have as following

Components	Details
CPU	Latest Intel Processor with latest available speed in the market at the time of delivery
Hard disk	250 GB
RAM	4 GB DDR
Operating System	Windows 7 or equivalent with latest service pack &

	patches
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4.22 General Requirements

1. In the event of the system failure in the lane, necessary manual mode shall be done by the cashier and plaza supervisors. The data and shift information for this period of time shall be captured into the MIS. This shall ensure data consistency. The data from manual mode operations shall be captured onto the TMS through administration terminal/s. An input and control screen shall be provided for this purpose. The cashier shall be required to submit a Manual Mode reconciliation Form at the end of the shift, the information provided on the Manual Mode reconciliation form shall be captured in the MIS.
2. Should the network connection between the cash-up terminal and the Central computer system be inoperative the cash-up data shall be stored in the terminal and transmitted to the Central Computer System when the link is restored. A method to transfer this information to disk/USB device shall be available.
3. The system shall recognise when data is incomplete from any lane and when a cashier has not completed full cash up (cash declaration, class discrepancies and exempt control etc) for periods worked up to the end of the operating day. Once an operating day is complete and validated, the shift must be closed.

4.23 Networking

The scope of work shall include Supply and System Integration of LAN from Lanes to CCS and integration with WAN (DND-MVL). The LAN will include active and passive components, all work relating to the structured cabling.

4.23.1 Technical Requirements

1. The entire network cabling for connecting all the TLC / AVC PC's to the central system should be of at least Cat-6 grade
2. Each TLC / AVC should have a redundant network port or card and should be protected against a single point of failure
3. The entire network should have a high-speed switching fabric backbone with redundancy architecture to ensure that the network connectivity is always available
4. For network connections spread over long distances, fiber optic cabling should be deployed, with high speed gigabit or better terminations to achieve maximum throughput
5. Network Connectivity between MVL and DND, also needs to be augmented by utilizing proper termination equipment to ensure a high speed network backbone between the 2 plazas. Any augmentation of fibre optic cable along with Fibre Termination Boxes between MVL and DND, if required, shall be done by NTBCL.
6. The network should not have a series of cascades, which would increase latency, no. of hops and also increase the points of failures in the network backbone
7. All network distribution should happen from a central plaza server / network room and all uplinks should be redundant
8. All the different plaza servers should be segregated into different VLAN's as per their role and secured behind a firewall
9. Only a limited, pre-defined set of ports would be allowed access between the various servers for communication and data exchange
10. All TLC & AVC PC's should also be segregated into a separate VLAN as would be all other Operations Back Office PC's

4.24 UPS

4.24.1 Lane, AVC & Back office UPS

4.24.1.1 Technical Requirement

Sr. No	Parameter	Specifications
1	Capacity	Bidder to specify
2	Battery Backup	30 minutes
3	Inverter Technology	Pulse Width Modulation (PWM) using IGBTs, double conversion
4	Switching Frequency	10 KHz or Higher
5	Total Harmonic Distortion (THD) Voltages	<2% for 100% linear load & < 3% for 100% non-linear load
6	Noise Level	Less than 55 dB
7	Operating Temperature	0° - 50°C
8	Output wave form	Pure sine wave
9	Cooling	Air Cooled
10	Input Voltage Range	160 VAC to 280VAC
11	DG set Compatibility	Shall be compatible
12	Input power Factor	0.9 or better at full output load leading to Unity with power factor correction (PFC)
13	Output Voltages	230 VAC +1% single phase
14	Regulation	Less than +1% in the following conditions a. No load to full load / Full load to no load b. 0.6 lag to Unity PF c. During Entire Backup time d. Complete Input Voltage Range

15	Frequency	50Hz +0.5 %
16	Over All Efficiency	Efficiency 80% or better on rated full load of 0.8 PF & 230V, 50Hz AC output
17	Invertor Efficiency	90% or better on rated full load of 0.8 PF & 230V, 50Hz AC output
18	Overload Capacity	110% for 2 min. & 125% overload for 30sec.
19	Load Power Factor	0.8 lagging
20	Protection	Required for : Short Circuits / Over Loading/ Over Temperature / Input low/ high voltage control/ DC low/high voltage trip
21	Battery recharge time (after complete discharge to 100% charge) & charge rating	Battery recharge time should not exceed 8 hours and charger should be capable to charge battery on C10 rating
22	Battery Capacity	Bidder to Evaluate
23	L.C.D meter	To measure and monitor input voltage, output voltage, output current, DC current, DC voltage input / output frequency
24	Indications	Mains on/ Load on Battery/ Inverter/ Battery level/ Load level/ Inverter over load
25	Audible Alarm	Over Temperature / Main failure/ Battery low/ Inverter Overload
26	Switches	Main ON/OFF MCB/ Battery ON/OFF MCB/ Inverter push button with reset.
27	Output Connection	O/P Terminals of standard quality should be provided. 03 Nos. of 5/15A/230V female ISI/ IEC Mark socket and all 3 sockets should
28	SNMP support and Static-bypass	Required
29	Isolation Transformer	Galvanic Isolation through Transformer

4.24.2 Server UPS

4.24.2.1 Technical Requirement

This UPS shall get power from central UPS and power the Lane equipment listed below :

Sr. No	Parameter	Specifications
1	Capacity	Bidder to specify
2	Battery Backup	30 minutes minimum
3	Inverter Technology	Pulse Width Modulation (PWM) using IGBTs in inverter & Rectifier section, Online double conversion
4	Switching Frequency	Free running Frequency
5	Noise Level	Less than 55 dB
6	Operating Temperature	0° - 40°C
7	Crest Factor	Not less than 3:1 on full non-linear load
8	Humidity	Up to 95% non-condensing
9	Output wave form	Pure sine wave
10	Cold Start Facility	Required
11	Cooling	Air Cooled
12	Isolation	UPS should be equipped with suitable capacity of isolation transformer in input side
13	Input Voltage Range	Single phase (160 VAC to 280VAC) or three phase (340 VAC to 450 VAC)
14	DG set Compatibility	Shall be compatible
15	Output Voltages	230 VAC +1% single phase or Three Phase
16	Regulation	Less than +1% in the following conditions a. No load to full load / Full load to no load b. 0.6 lag to Unity PF c. During Entire Backup time d. Complete Input Voltage Range
17	Frequency	50Hz +0.5 %

18	Over All Efficiency	85 % or better on rated full load of 0.8 PF 90% or better on rated full load of 0.8 PF
19	Overload Capacity	125% for 10 min. & 150% overload for 60sec.
20	Load Power Factor	0.6 lagging
21	Transient Response Time	For 100% load change, output must remain within $\pm 5\%$ and recovery within 20 ms.
22	Protection	Should be equipped with protection for Short Circuits, Over Loading, Over Temperature, Input low/ high voltage control and DC low voltage trip.
23	Battery recharge time (after complete discharge to 100% charge) & charge rating	Battery recharge time should not exceed 8 hours and charger should be capable to charge battery on C10 rating
24	Battery Capacity	Bidder to Evaluate
25	L.C.D meter	To measure and monitor input voltage, output voltage, output current, DC current, DC voltage input / output frequency
26	Indications	Mains on/ Load on Battery/ Inverter/ Battery level/ Load level/ Inverter over load
27	Switches / Isolators	Main ON/OFF Output ON/OFF Battery ON/OFF Manual Bypass Inverter push button with reset.
28	SNMP Support & Static Bypass	Required
29	Configuration	Hot-standby and Hot-swappable modules

4.24.3 Power Distribution

The bidder shall provide the following along with the UPS:

Power distribution cabling to all equipment including Distribution boxes including the required number of Miniature Circuit Breakers.

4.25 List of Makes of Off-The-Shelf (OTS) equipment

The bidder shall offer the following makes of equipment. Any other equivalent make may be accepted by NTBCL only on adequate justification supported by documentation.

S.No	Equipment generic description	Makes
1	Servers	HP / DELL/ IBM
2	Workstations	DELL/ LENOVO/ HP
3	Networking equipment	CISCO / NORTEL
4	Automatic Lane Barrier	MAGNETIC / EUROSBARRA
5	RFID Transceivers	3 M / IPICO
6	Receipt printer	EPSON
7	Report and other printers	HP / Canon
8	Bar code Scanner	Symbol (Motorola)
9	CCTV Cameras	Bosch / Samsung / Schneider (Pelco) / SONY / PANASONIC
10	UPS	Emerson, DB Power, LIEBERT, Electronic Control Power Systems
11	Cables	FINOLEX (for Power Cables) AMP (for CAT 6)
12	Intercom	AIPHONE

4.26 Spare Parts

4.26.1 Recommended Spare Parts

The bidder shall provide a list of recommended spare parts required for a period of two years for all the critical elements of the TCE based on their MTBF. The Equipment Supplier shall provide a list of the applied MTBF's for each spare part. Where possible, the TCE shall be developed utilizing equipment and parts available in India.

After approval of the spare parts list by the Operator, the equipment supplier shall provide an initial quantum of all spare part requirements. All the spare parts will remain with the client at the end of DLP.

4.26.2 Hot Standby Rig

A powered and functional toll collection system utilizing all equipment and peripherals of a Mixed lane shall be provided for use by the Operator's maintenance team. The system shall be constructed so that it can be installed in its entirety inside a room 3m x 3m. The system may be the same as the "rig" used for the factory acceptance of the toll collection system during factory acceptance testing.

The rig shall include a mock-up of the toll lanes that can be used to simulate passages of all vehicle classes as defined herein. The mock-up shall be suitable for training and demonstration purposes.

4.27 Routine Maintenance

The objective of electronic equipment maintenance shall be to ensure reliability, to prolong its economic life and to improve its efficiency.

4.27.1 Routine Maintenance

Routine maintenance consists of a fixed set of checks, measurement, cleaning and calibration. These activities shall be based on equipment supplier specifications and general maintenance practices that include:

- Checking the condition of components e.g. check connections for signs of deterioration.
- Check voltage levels. Power supply levels are crucial to the effective operation of electronic equipment. Borderline levels could lead to intermitted faults and damage to components. Voltage level changes are

caused by the deterioration of capacitors, transformers and semiconductor components.

Certain measurements can also be performed to check the status of elements of the system i.e.

- impedance and isolation tests
- Electro-mechanical motors and mechanical components need routine cleaning and lubrication to ensure their effective operation.

To ensure that routine maintenance is performed effectively, a routine maintenance procedure and routine maintenance schedule shall be prepared by the equipment supplier for implementation by NTBCL.

a) Routine Maintenance Procedure

A routine maintenance procedure shall be compiled for each sub-system and will include:

- Checks to be performed,
- Measurements,
- Cleaning and calibration.

These actions shall be structured according to time intervals i.e. short-term actions (daily), medium -term (monthly) and long-term (6 monthly or annually). The scheduling of these actions shall be based on the usage of the equipment, environmental conditions and the type of equipment. A matrix shall be drawn up indicating how the maintenance intervals vary dependent on the age of the equipment.

b) Routine Maintenance Schedule

A routine maintenance schedule pro-forma shall be compiled to ensure that each component of the system is maintained in accordance with the

maintenance procedures. The maintenance schedule shall also serves as a tool to control the downtime of equipment.

4.28 Software Maintenance Aspect

The equipment supplier shall ensure that software maintenance and upgrades are possible during the maintenance period. The following principles shall be adhered to:

- Source code shall form part of a deliverable item,
- Acceptable coding conventions shall be used,
- A high level coding language that is in general use shall be used
- Proprietary or not widely used proposing layered must not be used
- By and large open standards and inter-operable norms should be used

4.29 Service Levels

This section defines the TCE minimum service levels, and describes in broad terms the principles involved in maintaining the electronic equipment in order to provide the required minimum service levels. The bidder needs to provide a document on the approach and process to achieve these Service levels.

4.29.1 Availability

Availability means electronic equipment operating normally for its intended function. Availability is calculated on a three monthly moving average. Availability is expressed as a percentage e.g. availability of 98% implies that the equipment may have a maximum total downtime of 44 hours calculated over a three month period.

4.29.2 Mean Time To Repair (MTTR)

Mean time to repair means the average time taken to repair the electronic equipment back to a fully operational condition for the equipment to be able to

fulfil its intended function. The mean time to repair is measured from the time that the fault is detected to the time of successful equipment repair.

4.29.3 Service Levels Parameters

The minimum service levels for the various Toll Collection equipment (TCE) systems that will form part of the NTBCL is defined as follows:

Toll Collection System	Availability Months period	3 moving period	Downtime Total per 3 months Period	Mean Time to Repair
Toll Lane Equipment: <ul style="list-style-type: none"> Individual Lanes DND (Main) Individual Lanes MVL All Lanes Cumulative (sum of failures of individual lanes) 	97.7% 97.7% 98.9 %		50 Hrs 50 Hrs 1000 Hrs	4 Hrs 4 Hrs 4 Hrs
Voice Inter Communications: <ul style="list-style-type: none"> Individual Stations DND (Main) Individual Stations MVL All Stations Cumulative (sum of failures of individual lanes) 	97% 97% 98.9 %		50 Hrs 50 Hrs 1000 Hrs	4 Hrs 4 Hrs 4 Hrs
Toll Management System	99%		22 Hrs	4Hrs
ETC Backend System	99%		22 Hrs	4Hrs
TMS Workstations	95%		132 Hrs	4 Hrs

5 TOLL MANAGEMENT SYSTEM (TMS) REQUIREMENTS

1. The Toll Management System (TMS) is responsible for processing the data received by the CCS into information that is used to verify toll transactions, provide toll collector control and performance facilities, and shall include a host of management tools and reports for the effective administration of the toll operation. The TMS also assists in auditing the toll collection operation.
2. This shall be a modular unit with the capability for various modules and functions to perform independently at the different levels of the toll collection operation.
3. **Existing TMS system at NTBCL is described in this section (with comments indicating where a feature shall be a part of the ETC backend system). The bidders shall appropriately divide the functionality among the Toll Management System and the ETC Backend system as described in this RFP and design / describe their solution.** The bidders shall ensure all the required functionality and requirements are fully covered by their solution. Bidders may propose alternative TMS designs that incorporate newer technology features, intelligent screens, user friendly features, GUI reports etc. The solution must however always be intuitive and provide full functionality.
4. Transition from exiting system to new system shall be smooth without affecting performance of existing system, traffic etc. Bidder shall submit methodology for the same.
5. Proposed system shall have functionality to view real time viewing of LSDU data and reports in the head office at Mumbai. The bidder shall specify the bandwidth required for the same.

5.1 MANUAL MODE DATA CAPTURE

Data from manual mode operations is captured onto the TMS through administration terminals. Data consists of summarised cash transactions and itemised transactions for all other methods of payment. The input shall be a batch process, and the system shall provide validation of captured data in the same way as the TLC, i.e. it provides warning when validating credit card transactions. The system allows an over-ride to accept unauthorised transactions already processed. The system shall also update ETC accounts for transactions manually processed.

5.2 REVENUE CONTROL

5.2.1 Vault

All cash is controlled (in both value and denomination) through a “vault” account. The vault account is split into two sections:

1. Residual Vault
2. Vault in process

Both vault accounts are passed on, within the TMS from one cashier/supervisor to the next.

Residual vault – this is the account where plaza change is kept. This amount is increased or decreased by transfers to the bank (financial institution). Change is issued to the Vault in Process by means of an “exchange” of like value but different denominations.

Vault in process – This is the account where lane floats are issued from and returned to, and where bleed off and cash up is transferred. Transfers out of this Vault in process are deposits to the bank (financial institution).

5.2.2 Operating day

The operating day and the financial day is the same period. This is midnight to midnight. The financial month will close at midnight on the last day of the month. The system must automatically log every lane out and in at midnight. This includes inactive lanes. This will create a “virtual” shift end.

5.2.3 Data incomplete

The system must recognise when data is incomplete from any lane and when a Toll Collector has not completed full cash up (voucher and cash declaration) for periods worked up to the end of the operating day. Once an operating day is complete then it must be flagged and no information can be changed (at normal operating levels) for that day.

5.2.4 Cash up Process

1. **Local Mode in lanes** It must be possible to draw-out a “mini shift report” on the lane printer. The report shall be selected for a period of time worked in the lane and must disclose lane and collector details, each method of payment by class and total, all ETC transactions with the E-ID and discrepancies.
2. **Virtual Cash Up** will occur for all non-cashed up shifts up to the end of the operating day. When the collector next cashes up, the system must allocate sufficient cash to the previous operating day to balance those shifts to zero. Any surplus or shortage will be brought forward into the next operating day and be declared in that collector shift.
3. **Money declaration** All personnel who have been logged into the lanes or have collected toll revenue (ETC, exempt, violation, cards) will do this. No information on “required” money will be available to the collector before they have declared their money. Any changes in money declared must be logged.

4. **Voucher input** Once money has been declared the system will automatically present a screen presenting the vouchers for violations and exempt in sequential order. These are to be completed. Where details are insufficient the voucher will be charged against the collector.

5. **Sundry Payments**

Amounts collected for toll revenue other than that for cash method of payment, are to be allocated as receipted amounts. The value and allocating must be available on the cash declaration screen.

5.2.5 **End of Shift Document**

This document must be printed automatically for each virtual and manual cash declaration. It will consist of at least: -

1. Declaration

- Heading (name, period etc)
- Value declared
- Sundry payments processed
- Calculated lane cash
- Base Revenue
- Shortage/surplus (add/subtract discrepancies)
- Signatures of collector and supervisor with date

2. Manual input (voucher report)

- Vouchers entered by method of payment
- Credit Card numbers captured manually
- ETC captured manually

3. Summary of shifts

- Time periods logged into lanes

- Associated transaction numbers
- Value of transactions
- Lane status of each period

4. Shift Incidents

- Incidents as selected in the parameters

5. Shift Income report per tariff and total

- Value by method of payment and class
- Traffic by method of payment and class

5.3 BANKING PROCESS

All plaza revenue is kept in a single bank account reserved purely for toll revenue. Bank charges will not be reflected in this account.

5.3.1 Deposits to bank from plaza

Deposits will be made only from the vault account. The TMS will control and be able to report on date and time, values, denominations, bag seal numbers and responsible person of all transfers from the vault account to the bank. It is not necessary to control the returned deposit slip but it must be able to report activity.

5.3.2 Change requirements of the plaza

The TMS must be able to record all increases, decreases and changes in the residual vault with the necessary detail.

5.3.3 Direct bank transfers from Cards

On confirmation from the bank of a direct transfer into our account, the payment details are entered directly into the Debtors System as a batch entry with the corresponding entry against each rolled up entity or where not rolled up, directly against the card number. This feature shall now be a part of the ETC backend system.

5.3.4 Direct bank deposits from ETC

On confirmation from the bank of a direct transfer into our account, the payment details are entered directly into the Debtors System as a batch entry with the corresponding entry against each ETC account. This function shall now be performed by the ETC backend system.

5.4 DEBT CONTROL

Debt control shall be integrated into the TMS. All methods of payment are automatically transferred into debt control. These transactions must reconcile to the Income for the operating day in control accounts and sub accounts.

- Cash is reconciled within revenue control (section 5.2)
- Exempt transactions are originated in the lanes
- Credit (Funds paid by road users in the lane to top-up their ETC account) and other vouchers is entered at cash up
- Cards are rolled up and transferred per bank
- ETC is transferred per transaction

Receipts and adjustments are maintained using double entry accounting practices. The debtors control system shall present a true monthly representation of the operations debt position.

Debt control function shall be appropriately performed in the TMS and the ETC backend systems.

5.5 CREDIT CARD FUNCTIONALITY

The card transactions be summed per operating day and transferred in batches into a debtors account (per bank). The debtor account module resides within the TMS. Payments and commission will be processed into this control account. This feature shall be a part of the ETC Backend System. Payment of Toll with credit card at the lanes and credit-card based lane re-charges of ETC account shall be a part of the TMS.

5.5.1 Validation

This is performed during the transaction by an on-line authorization by the acquiring bank switch / host.

5.6 ETC ACCOUNTS

ETC accounts are currently controlled in the TMS. In the proposed upgrade system they shall be controlled by the ETC backend system. One account can have more than one E-ID. ETC accounts are prepaid. System should send SMS upon recharge and for giving advance intimation of expiry of the balance. Minimum balance/trip upon which, SMS should be send has to be settable parameter.

5.6.1 Registration

Registration is completed in the POS by the completion and signing of an automatically printed application form, the payment in advance for a minimum number of passes, and the issue and installation of the E-ID. There must be a facility to charge an E-ID fee and a fee for statements, replacement E-ID etc.

5.6.2 Recharges

These are to be made either in the POS or through direct bank transfers. Out of peak times recharges will be allowed in the lanes. The E-ID number is captured (electronically), value entered as a sundry payment and a receipt is automatically produced. Recharges immediately get credited to the account and the new balance is reflected in all lanes.

5.6.3 Maintaining Current Balances

Balances are currently maintained within the TMS as a subset of the debtor module. In the proposed system they shall be maintained in the ETC backend System. System shall have provision to store online data on the smart card, OBU and RFID Tag in a secure manner. The balances of the E-ID's are regularly sent to the lanes so that the lanes can reject transactions with limited balance, advise users of low balances and reject invalid, hot or overdrawn E-

IDs. Discounts, rebates and adjustments can be processed to the account (usually on a monthly basis). Overall control of income and debt is through the debtors system.

It must be able to easily enquire and print transactions, statements and balances

5.6.4 Fraud Detection

E-ID's may not be copied or transferred to other vehicles without prior approval. Exempt E-ID will have an expiry date and be clearly identifiable as an exempt user. It must be possible to query the database. There must be access control into discount/rebate structures and adjustments. Changes are to be logged and reportable. There must be a facility in the POS to test E-ID's without creating a financial transaction.

5.6.5 Invalidation

It must be possible to: -

- Withdraw an E-ID
- Exchange/transfer
- Blacklist as stolen, lost or no balance.

5.6.6 Closing and Opening monthly balances

The account will run for a calendar month (midnight to midnight). Statements can be drawn for each separate month with the balance carried forward to the next month.

5.6.7 Account Termination

The system shall allow the termination of an ETC account. Refunds have to be made external from the system. However it shall be possible to include any Write off and adjustments..

5.7 TREATMENT OF EXEMPT ACCOUNTS

An image shall be captured for each exempt transaction. Exempt passages are controlled in the debtors' control.

5.8 SUNDRY PAYMENTS

These are limited to payment of violations;, exempt vehicles, collector debts and ETC recharges and charges, fines, excess charges etc. All payments are entered into the debtor system as batch inputs. All batches are checked for being in balance and accurate prior to posting.

5.8.1 Points of Sale

Currently Points of Sale (POS) are part of the TMS. In the proposed system they shall be a part of the ETC backend system. POS shall be equipped to create user accounts, issue tags and cards against the same and rec-charge accounts. Web based graphical user interface shall be provided. The POS application shall be a part of the ETC Backend System. Points of sale are to administer sales, account credits, lost cards, stolen cards, queries etc. Emphasis should be given to a POS system that shall provide secure transaction and administration functions to the ETC backend system.

5.8.2 Lane recharges

Lanes will be capable of receiving ETC recharges by electronically capturing the E-ID, entering the value and printing a receipt. These amounts will be reflected in the cash declaration. Payment by Credit Cards shall be handled as described in Section 5.5. A lane recharge appears as an **ETC User credit transaction** in the TMS which is transferred (via the ETC Client like other ETC toll transactions) to the ETC backend system for processing and settlement.

5.8.3 Administration department

Administration will be able to access a sundry payments menu that will allow the entry of direct bank transfers, cheques and cash received. The input screen must provide for entering to the following debtor accounts: -

- Violations
- Credit Granted
- Exempt
- Staff debt accounts
- Miscellaneous items

ETC payments and recharges are entered directly into the ETC account..

Collector debts

Collector debts are created when a voucher is rejected as not having sufficient information. This amount is forwarded to the debtor module. Collector debts are paid via sundry payments.

5.9 COLLECTOR MANAGEMENT

The TMS must provide reporting facilities that present data that can be used to evaluate collector performance. The bidder shall refer to the section on reporting for a list of facilities required.

5.9.1 Discrepancies

A difference between the collector classification or E-ID class and the AVC creates a discrepancy. All discrepancies will have the vehicle images (or video) captured. The images / video is sent “real time” to the control room where the supervisor will correct the classification to that of the image. Under classifications will be added to any shortage or reduce any surplus. Over classifications will require surplus money from the collector.

5.9.2 Surplus cash

Surplus cash reflected in the cash declaration will be deemed to belong to the Concession and must be banked as such. This amount will include the value of over classifications corrected.

5.9.3 Shortages

These amounts are reflected on the cash declaration and are to be paid by the collector at least once per month.

5.9.4 Vouchers deemed to be paid

Any voucher that does not have a correct account number and sufficient details (see required voucher input details) will default to “paid”. This value is deducted from the declared cash. Violations, credit granted and exempt can all result in “paid” amounts.

5.10 REPORTING

All reports must be available to view, print or in a TXT or CSV format file for suitable and easy spreadsheet analysis. Many may be required in chart or graph form. Indicative list of reports is indicated below. The solution should have a report writing utility, to help add more customised reports instantaneously as per new information requirements without external help/intervention of bidder/supplier.

5.10.1 Income Reports

- Comprehensive report
- Violation report
- Credit granted report
- Excess income report
- Discrepancy report
- End of operating day report
- Collector shortages report

5.10.2 Revenue Reports

- Cash up report
- Daily cash reconciliation report
- Monthly cash reconciliation report
- Sundry payments report
- Daily vault movement report

- Vault hand over report

5.10.3 Lane Maintenance reports

- Lane computer performance
- Lane equipment failure
- AVC discrepancy report

5.10.4 Traffic Reports (Lane-wise & Cumulative)

- Hourly traffic
- Daily Traffic

5.10.5 Incident reports

- Collector discrepancy
- Acknowledged incident report
- E-ID manually entered using keyboard (in case of failure of direct electronic read of ETC media)
- Manually captured E-ID (captured using Bar-code reader)

5.10.6 Payment reports

- Exempt transactions
- Concessions
- Discounts
- Rebates

5.10.7 Enquiry reports

- Card reports
- Card enquiry
- Usage report
- Adjustments report
- ETC reports

- Usage report
- E-ID stock (Issued/un-issued)

5.10.8 Productivity reports

- Productive time
- Productive time summary
- Manning level report

5.10.9 Debtor Reports

- Age trial balance
- Statements by selected account number
- Statistics (i.e. average days outstanding)

5.10.10 Miscellaneous Reports

- Problem data report
- Data status reports

5.10.11 Performance Reports

- Comparison of traffic by lanes / months
- Comparison of traffic by class / mode of payment
- Monthly collection analysis by class of vehicles
- Report by high / low usage of cards
- Report on lanes shut down for maintenance more than the normal time
- Maintenance Reports of lane equipment
- Operator efficiency Performance report
- AVC Accuracy Report (by Shift, Lane, Time Frame, Toll Collector, etc.)
 - ✓ AVC – Supervisor Class
 - ✓ AVC – TLC/MVC
 - ✓ Supervisor Class - TLC

5.10.12 Audit Trail Reports

- Cash declared changed
- Discrepancies corrected
- Tariff changes and fare table implemented
- Changes to database
- Access to system
- Edit of incident table
- Edit lane operation rules
- Edit access tables
- Password changes
- ETC transactions and balance survey (as and when required)

5.11 BACKUP SYSTEM

5.11.1 Data Archiving

Both the TMS (Part A) and the ETC Backend System (Part B) shall have provision of Data archiving as described below:

Summarised data shall be archived on removable media on a regular basis so as to free system resources. All plaza level data shall be transferred to removable electronic media at monthly intervals and stored.

After the expiration of the prescribed period for retention of the data on the various system levels, the data may be removed from the systems. The TMS shall provide the facility to perform these functions.

The archived data written to the magnetic media shall be fully accessible by the TMS and the various reporting facilities of the TMS without the necessity of having to restore the data. Note Plaza level shall be any level other than the toll lane equipment and systems.

5.11.2 Data Backup and Restore

Data shall be backed up onto a removable medium on a regular basis for removal from the premises. e.g. once a month.

5.11.3 Data Redundancy

All transaction and incident data shall be retained, duplicated and stored within the various levels of the toll collection system such that should any level or component of that level suffer a partial or total failure, the data is not irretrievably lost to the system. In addition, it shall be possible to reconstruct and restore the data for the failed level from the stored data into its original format.

Data retention times within the various levels shall be at least:

- Vehicle Processing / Lane Level : 3 months
- Plaza level Detailed Data : 12 months
- Summarised Data : 24 months

5.12 DATA IMPORT / EXPORT SYSTEM

5.12.1 Bank: ETC user account deposits

Import format and interface shall be established with major banking institutions nominated by NTBCL. The information to be imported is ETC user payments into the NTBCL / Operator's bank account. The TMS shall export ETC user account information to the TLC (e.g. account balance, blacklisted accounts, user status etc.)

5.12.2 Traffic Information

To a comma delimited or MS Access compatible database file.

5.12.3 To an ERP (viz. SAP and others) Package

The TMS shall provision to interface with such an ERP package. Details will be provided to the successful bidder.

5.13 SECURITY SYSTEM

A facility to allow the system administrator to manage users and their access levels. The TMS shall at its highest level determine access to the separate modules by any employee. It shall have the facility to define the employee according to an associated level or duty, and provide a mechanism whereby access is restricted.

Login identity/password will not be acceptable in the toll lanes or at supervisor level. The use of magnetically coded cards, biometrics or other technology that is not easily shared, copied or abused should be considered.

Building access shall also be controlled by electronic means for security reasons. This system should share common data with the TMS and TLC software access control

The bidder must indicate the access levels processed in the system and rights that can be assigned and possibility built inside the system.

6 SYSTEM PERFORMANCE REQUIREMENTS

6.1 USER INTERFACES

6.1.1 Lane

Specify parameters that govern the speed of lane processing. The areas that impact on transaction speed are

6.1.1.1 Mixed lane

1. E-ID (For Smart card and RFID tag)validation (including verification with the ETC Client): Less than 0.5 Second
2. Receipt printing: Less than 2 Seconds
3. Recharge
 - ETC E-ID: Less than 5 Seconds
4. Transaction completion - time from leaving the AVC area until ready for the next transaction: 1 Second

6.1.1.2 ETC lane

1. Pre-entry checking in Gold Lane
 - E-ID validation Less than 0.2 Seconds
2. Lane transaction
 - E-ID Transaction Less than 0.2 Seconds

6.1.2 Cash-up

The time required to complete a collector cash-up is crucial to effective operation of a toll plaza. The cash-up process needs to be optimized. The following parameters will be measured:

- 1) Collector logon: Less than 2 Seconds
- 2) Supervisor logon: Less than 2 Seconds

- 3) Voucher updating: Less than 2 Seconds per voucher

6.1.3 Control room

Various control room functions should be near real-time to allow for effective operations. The following relate to information displayed at control room level on the LSDU or incident management system:

- 1) Lane incident reporting: Less than 2 Seconds
- 2) Lane status reporting: Less than 2 Seconds
- 3) Lane transaction reporting: Less than 2 Seconds

6.1.4 General reporter

- 1) The delays due to the system to request a report should be less than 60 Seconds (System delay < 60 seconds).
- 2) Time to print should be less than 1 minute. The time to print refers to the time from completing the task to the point of submitting the report to the print spooler.

6.2 REPORTS

The processing speed of certain reports impacts directly on the Operations effectiveness. In these cases specific requirements are specified.

6.2.1 Lane

- 1) Lane EOS report
 - a) Format. This report is printed on receipt paper and should be formatted to save paper. The report should use less than 500mm of receipt paper, excluding detail transaction listing.
 - b) Time to print: less than 30 second, excluding detail transaction listing.
- 2) Other lane reports: less than 30 seconds

6.2.2 Cash-up

- 1) Deposit slip printing System delay less than 10 seconds, time to print less than 20 seconds.
- 2) Individual EOS printing System delay less than 10 seconds, time to print less than 20 seconds.

6.2.3 Control room

- 1) End-of-shift audit report System delay less than 10 seconds, time to print less than 60 seconds.
- 2) Daily cash reconciliation report System delay less than 10 seconds, time to print less than 60 seconds.
- 3) Daily cash banking report System delay less than 10 seconds, time to print less than 60 seconds.

6.2.4 Daily reconciliation reports

- 1) Daily comprehensive report System delay less than 10 seconds, time to print less than 120 seconds.
- 2) Concession and discount cost report System delay less than 10 seconds, time to print less than 120 seconds.
- 3) Collector shortages report System delay less than 10 seconds, time to print less than 1 minute.
- 4) Vault reconciliation report System delay less than 10 seconds, time to print less than 1 minute.
- 5) Problem data report System delay less than 10 seconds, time to print less than 1 minute.

6.2.5 Monthly reconciliation reports

- 1) Monthly comprehensive report System delay less than 10 seconds, time to print less than 5 minutes.
- 2) Concession and discount cost report System delay less than 10 seconds, time to print less than 5 minutes.

- 3) Collector shortages report System delay less than 10 seconds, time to print less than 5 minutes.
- 4) Cash reconciliation report System delay less than 10 seconds, time to print less than 5 minutes.
- 5) Problem data report System delay less than 10 seconds, time to print less than 5 minutes.

6.3 COMMUNICATIONS AND DATA UPDATING

The following items impacts directly on the lane processing and plaza operations.

6.3.1 Balances and Blacklisting

The time to update balances will be monitored closely. The system shall incorporate a tool that displays the average time from processing a transaction up to the point of receiving an updated white list, blacklist and balance list in the ETC Client. The system shall comply with the following criteria:

- 1) Update on completing a transaction: less than 20 minutes.
- 2) Update on completing of a recharge.

Recharge point:

- a) Lane: Less than 20 minutes.
- b) Sales point: Less than 20 minutes.
- c) Web-based: Less than 20 minutes

6.3.2 Bank card roll-up

The time to compile the bank list roll-up shall be as follows:

- Perform roll-up per bank: less than 20 minutes.

6.3.3 Month-end roll-up

The month-end closing functions are done as a background process and should not exceed the following parameters:

- Calculate closing and brought forward amounts: less than 1 hour.
- Compile summarized data: less than 1 hour.

6.3.4 Importing local mode data

System recovery after communication failures is crucial to keep the off-card/E-ID account balances correct. The following criteria shall be met under full system operation.

6.3.4.1 Lane to plaza communication failure

All re-transmission in less than 30 minutes per full operating day of lost communication per lane. All system tables (excluding items that require manual input e.g. cash-up) will be up to date after the completion of the retransmission.

6.3.4.2 Plaza to operational level

All re-transmission in less than 20 minutes per full operating day of lost communication.

6.3.5 Re-transmitted data

Data requested from a lane will update all the related tables as follows:

- Individual recharges, transactions or incidents: less than 60 seconds.
- Range of recharges, transactions or incidents: less than 2 minutes per hour of requested data.

OTHER INTERFACES

6.3.6 Remote sales points

6.3.6.1 Online connection

Online transaction will be communicated to the plaza every 5 minutes. The data will be processed within 30 minutes.

6.3.6.2 Off-line data z

Off-line transaction will be transferred to the plaza every shift (8 hours). The data will be processed within 30 minutes.

6.3.7 Bank Interface

User deposits will be transferred to the plaza every 2 hours or as frequently as the banks are able to transmit the data, to an optimum real-time situation. The data will be processed within 30 minutes.

6.3.8 Audit counter

Data from the audit counters will be imported into the TMS on a daily basis. The TMS will process this data in less than 30 minutes.

6.4 ARCHIVING/RESTORE

The data archiving shall meet the following criteria.

- 1) Archive a full operating month of data
 - a) Prepare archived files: less than 2 hours.
 - b) Write archived files onto media: less than 2 hours.
- 2) Restore archives: less than 2 hours per full operating month.

6.5 MEASUREMENT

The above will be measured using a stopwatch. A potentially busy period (system resources will be fully utilized. This can be simulated or test) will be used to perform the tests. In most cases, user and system activity occur at same time. In such cases, the system delay is measured. This will be measured by:

- Measuring the total time from performing the task
- Measuring the user's time
- Calculating the system delay by deducting the user time from the total time

6.6 STRESS TESTING

6.6.1 Purpose of the tests

The aim of the stress test is:

- To establish if the design criteria are achieved
- Validate system stability
- Establish overstress limits and symptoms

7 DOCUMENTATION AND TRAINING REQUIREMENTS

7.1 Documentation

The successful bidder shall ensure that the following documentation is provided:

7.1.1 Technical Documentation

- Technical Proposal (Based on RFP)
- Functional Specifications
- Equipment Technical Specification
- Equipment Service Manual
- System Drawings
- As built Drawings
- Software codes/Escrow for all applications

7.1.2 Equipment User Manuals

- User Manual – Lane Software
- User Manual - LSDU
- User Manual – TMS, ETC Backend System
- User Manual - POS
- User Manual - CCS

7.1.3 Quality Assurance Plan

The bidder shall submit a comprehensive Quality Assurance Plan within 15 days of award of work / Letter of Intent (LOI) by NTBCL.

7.1.4 Acceptance Testing

1. **Factory Acceptance Test (FAT):** Program , Procedure and Tests

- The products/equipment may undergo Factory Acceptance Tests at the Successful Bidder's or the OEM's warehouse/store by the team designated by NTBCL.
- The Successful Bidder, at no cost to NTBCL, shall rectify any discrepancy found during and after the Factory Acceptance Tests in the products/equipment.

2. Site Acceptance Test (SAT) : Program , Procedure and Tests

- These tests shall be performed during the phase of setting up the backend system and the progressive commissioning of the lane system.
- The Successful Bidder shall prepare the Site Acceptance Test Procedures for the equipment and the TLC, AVC, Lane equipment, TMS, Software network functionalities and get the same finalized with the NTBCL's testing teams, within 30 days from the date of Letter of Intent (LOI)
- NTBCL reserves the right to ask for modifications/additions to the Site Acceptance Test Procedure at any point of time till the Site Acceptance sign-off of each location DND/MVL

3. System Integration Test (SIT) : Program , Procedure and Tests

- The Successful Bidder shall prepare the SIT Procedures for the network functionalities and get the same finalized with NTBCL within 30 days from the date of Letter of Intent
- NTBCL reserves the right to ask for modifications/additions to the Test Procedure at any point of time till the Final Acceptance sign-off
- The SIT shall also cover the Functional Tests of the LAN and WAN network. The SIT Procedure shall also include tests to verify the data, voice and video traffic handling capability of the LAN

- The SIT will start after Site Acceptance Sign-off is completed successfully
- The Successful Bidder shall carry out the SIT in the presence of NTBCL officials
- Successful Bidder, at its own cost shall provide the required testing equipment/instruments/software programs necessary for performing and demonstrating the SIT. Successful Bidder shall rectify all deficiencies immediately, if found, in the performance of the system as per the requirement during the SIT, at no cost to NTBCL
- Once all the SIT are completed successfully, to the satisfaction of NTBCL, the required Trainings as per Section-7.1.4 can successfully be completed and the handover of all sites (DND/MVL) can take place

7.1.5 Training

The equipment supplier shall provide a training schedule detailing the scope of training that will be provided by the equipment supplier to the Operator for the Operator's approval. This will include training for Lane procedures, LSDU utilization, TMS use, CCS maintenance and TCE system maintenance.

An interface HTML based learning document should be created for different user profile providing detail hub on the system featuring use of the application and also indicating trouble shooting options.

7.2 DOCUMENTATION PLAN

The bidder must indicate documentation and training plan and define specific documents to be delivered, their intent and content, the schedules for preparation, review, submittal, validation when necessary, and revision and update.

The bidder shall elaborate the training strategy for this project. The plan must indicate training process, number of sessions to be conducted, types and mode of conducting training, post training feedback, refresher training, on-line as well as distant learning etc.

The numbering system to be used to identify and track the documentation and to permit their configuration control shall be prescribed by NTBCL.

Documents relating to proprietary or commercially available hardware and software shall be provided.

7.2.1 Test environment

The contractor shall setup a test environment that simulates the actual installation prior to delivery of the system to site. The simulation will consist of:

- 1) The required number of lanes
- 2) The correct network boxes and equivalent cable types
- 3) Servers and workstations

7.2.2 Simulation

Simulation software will be used to simulate the various activities:

- 1) Lane process simulation that simulates the following
 - a) User and peripheral inputs e.g. classification, validation or recharges
 - b) Required mix of transactions and incidents according to settable parameters
 - c) Variable transaction rates
 - d) Database containing 3 months of data as per the design criteria
- 2) System processes. The normal system processes will run. The software will display the following
 - a) Lane communication progress per lane

- b) Blacklist and balance status per lane
 - c) Average transaction to updated balance/blacklist times
 - d) Communication queue lengths
- 3) Various scenarios will be simulated
- a) 100 – 300% of designed traffic volumes
 - b) 100 – 300% of designed traffic processing tempo
 - c) Recovery from 1 day of communication to all lanes with the above two scenarios.
- 4) Items to be tested during the stress test. The following will be tested while the test simulations are running
- a) The above-specified criteria will be measured.
 - i) Interfaces
 - ii) Reports
 - iii) Communication and data updating
 - iv) Other interfaces

8 IMPLEMENTATION AND POST IMPLEMENTATION SUPPORT REQUIREMENTS

The DND plaza and MVL plaza are two independent plazas geographically separated by approx 4.2 Kms and connected by dedicated OFC. The plazas are integrated and presently have common database and function on a single TMS. bidders needs to build up the capability to allow NTBCL to have the option of continuing operating these in an integrated manner and / or independent of each other.

Bidders need to emphasise on one of the key requirements of this modernisation program is that of swift transition with minimal impact and ensuring uninterrupted operations under old/new environment until entire modernisation phase in not concluded. All the bidders need to provide a comprehensive approach with detailed stage / phase wise implementation process that will be adopted in this project with definable milestones.

Expected time frames for implementation by the bidders are as follows:

Sl.No	Event	Target Date
1	RFP's to vendors	March 10, 2014
2	Pre Bid meeting	March 18, 2014
3	Submission of technical and commercial proposals	April 4, 2014

9 APPENDICES

9.1 APPENDIX I – GLOSSARY

“Operations Date ” means the date from which Fees are levied on the users of the facility

“User” means the person(s) who traverse or travel over or on the Facility or any portion thereof transporting any goods or persons.

“Facility” means the Noida Bridge and associated facilities as detailed in Chapter 2

“Concession” means a deduction that is calculated at the time that the transaction occurs and can be displayed in the lane and printed on the receipt.

“Discount ” means a deduction that is calculated after the event and is based on period, frequency or parameters relating to the use of the toll route.

“Electronic Toll Collection“. in the context of this project includes the methods of ‘Electronic’ payment using the Smart card or the RFID Tag as well as any OBU (On board Unit).

S.No	Acronym	Description
1	ALC	Automatic Lane Classification
2	BOOT	Build Own Operate Transfer
3	CCS	Central Computer System
4	CCTV	Closed Circuit Television
5	DND	Delhi Noida Direct Flyway
6	DVR	Digital Video Recorder
7	Eoi	Expression of Interest
8	EOS	End of Shift
9	ETC	Electronic Toll Collection.
10	FAT	Factory Acceptance Test
11	IC	Incident Computer
12	IL&FS	Infrastructure Leasing & Financial Services Limited
13	IT	Information Technology
14	ITMSL	Toll Management Services Limited
15	ITNL	IL&FS Transportation Networks Limited
16	LPR	Licence Plate Number Reader
17	LSDU	Lane Status Display Unit
18	MBC	Manual Booth Controller
19	MCD	Municipal Corporation of Delhi
20	MOP	Methods of Payment
21	MTBF	Mean Time Between Failure
22	MTTR	Mean Time to Repair
23	MVL	Mayur Vihar Link Plaza
24	NTBCL	Noida Toll Bridge Company Limited
25	OHLS	Overhead Lane Sign
26	OBU	On-Board Unit
27	OS	Operating System
28	POS	Point of Sale
29	PPP	Public Private Partnership
30	RFID	Radio Frequency Identification
31	RFP	Request for Proposal
32	RP	Receipt Printer
33	SAT	Site Acceptance Tests
34	SCR	Swipe Card Reader
35	SLA	Service Level Agreement
36	SLP	Service Level Parameter
37	TCE	Toll Collector's Equipment
38	TCD	Toll Collector's Display

39	TCT	Toll Collector's Terminal
40	TL	Traffic Light
41	TLC	Toll Lane Computer
42	TMS	Toll Management System
43	UFD	User Fare Display
44	USB	Universal Service Bus
45	VCI	Vehicle Class Indicator
46	VDU	Video Display Unit
47	TLS	Toll Lane System